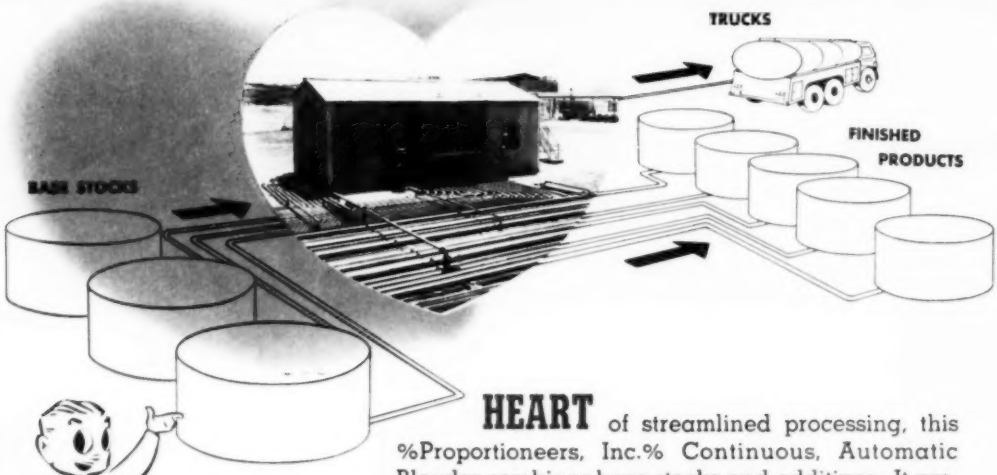
OCTOBER, 1951
VOL. 6, NO. 10

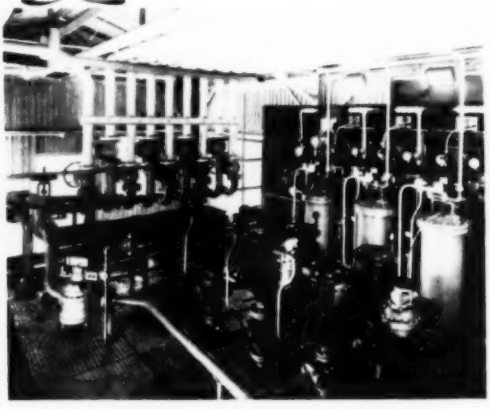
# PETROLEUM PROCESSING

5 Fire Fighting Lessons Proved
By Tank Farm Blaze . . . p. 1112

# BLEND COMPONENTS



**HEART** of streamlined processing, this %Proportioneers, Inc.% Continuous, Automatic Blender combines base stocks and additives. It provides new speed, flexibility and economy in the production of uniform blends. The system reduces manpower, eliminates blending tanks, agitation, auxiliary pumps and attendant piping. Because the finished product is immediately available, tank trucks can be loaded without waiting. The %Proportioneers, Inc.% Continuous, Automatic Blender, preset to formula, controls component ratios and permits quick adjustment of output to suit demand rates. This installation at refinery of Richfield Oil Corporation at Watson, Calif., delivers a variety of finished products, exactly to formula, to trucks and/or storage tanks.

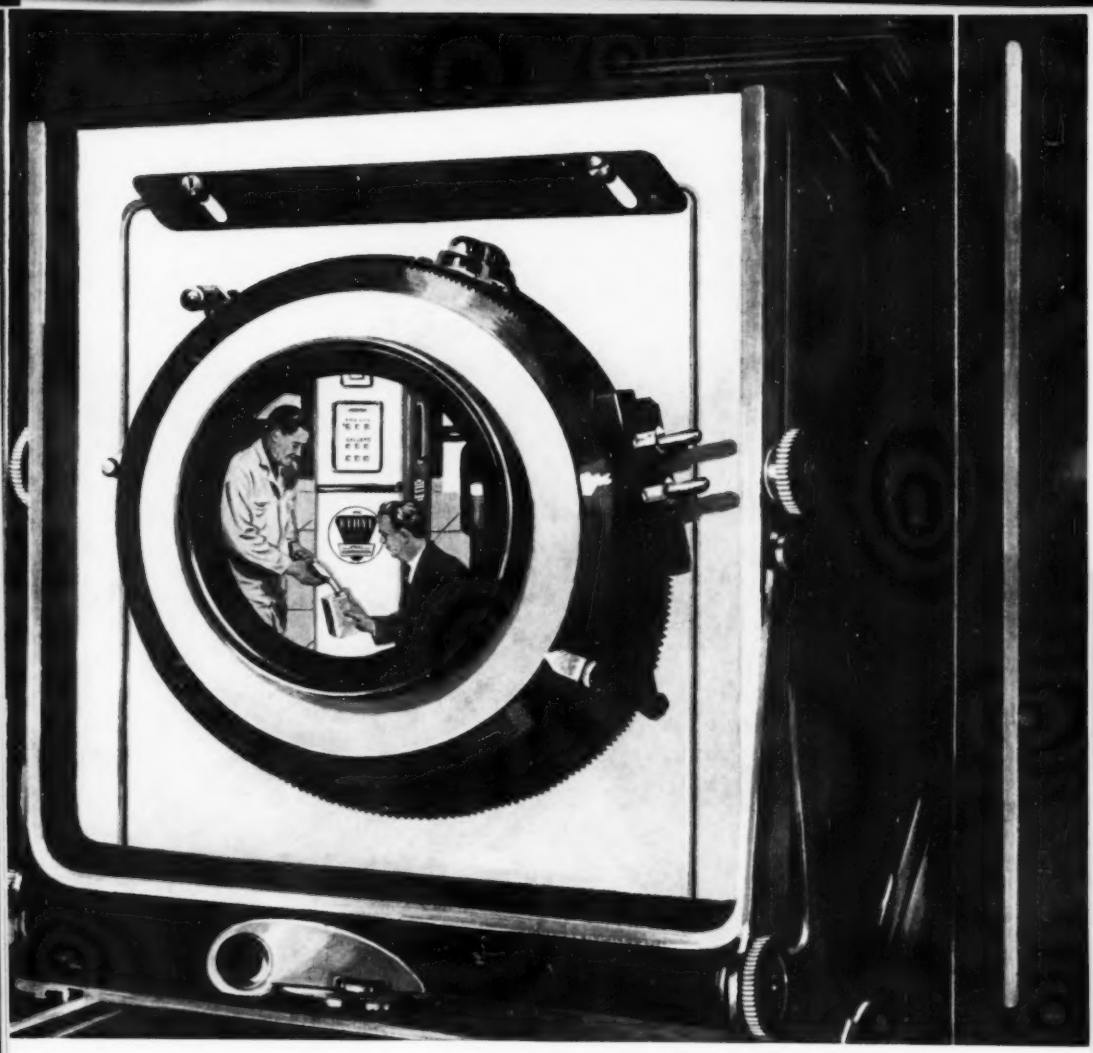


*Ask for recommendations and descriptive literature*

# % PROPORTIONEERS, INC. %

Write to %PROPORTIONEERS, INC.%, 447 Harris Ave., Providence 1, R. I.

Technical service representatives in principal cities of the United States, Canada, Mexico and other foreign countries.



# 14,000 "takes" to give you a clear picture of gasoline trends

It's a lot easier to get a picture of the trend in automobiles than it is to check up on the trends in the fuel that runs them. After all, there are only twenty-odd makes of cars manufactured in the United States, but there are hundreds of oil companies marketing their various brands of gasoline.

In order to furnish you with accurate gasoline-quality information, Ethyl tests more than 14,000 samples a year. These samples are obtained both from refineries and retail pumps throughout the country and furnish the data for national and regional surveys of gasoline quality. Five specially equipped testing laboratories, staffed by experienced technicians, are constantly assembling facts on antiknock value, gum content, distillation and other characteristics.

It's pretty hard to imagine each individual oil company spending the time and effort to do this job for themselves on a

(*Continued on next page*)

ETHYL
ETHYL CORPORATION

## 14,000 "takes" to give you a clear picture of gasoline trends

*(Continued from preceding page)*

national basis. That's why we feel this Ethyl service—which aids all oil companies—is one of the most worth-while we offer.

However, furnishing over-all gasoline quality surveys is only part of the service Ethyl's Gasoline Testing Laboratories offer the petroleum industry. Information on the octane number and lead response of the gasoline and component stocks of individual refiners is furnished them to assist in their work of preparing their own finished gasoline blends.

Our personnel, who are thoroughly skilled in the operation of CFR knock-testing engines, are always available to assist refiners in the maintenance and operation of their own knock-testing equipment. And, naturally, we can be of special help to oil companies who do not have their own testing facilities.

By the way, any time you are in Yonkers, New York; Kansas City, Missouri; Tulsa, Oklahoma; Baton Rouge, Louisiana; or San Bernardino, California, we'd be pleased to have you drop into one of our Gasoline Testing Laboratories to see at first hand all that Ethyl is doing along these lines.

**ETHYL CORPORATION**

**NEW YORK 17, N. Y.**

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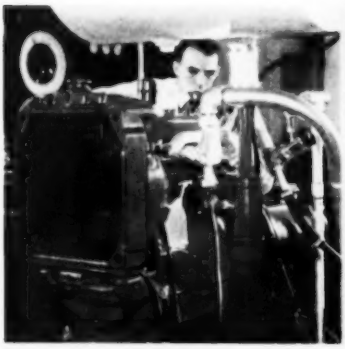
*is the most important ingredient in "Ethyl" antiknock fluid*



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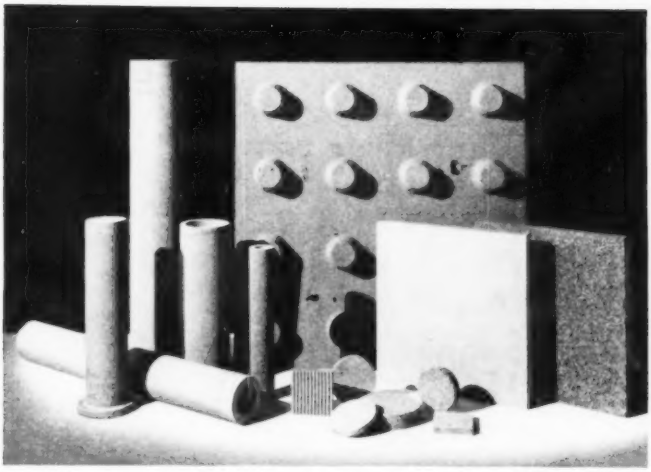

Gas-diffusing or filter mediums of Norton ALUNDUM* fused alumina are manufactured for a wide variety of commercial and laboratory operations.

# Why should your porous mediums be uniformly porous?

Porosity may be defined as the percentage ratio of pore space by volume to the bulk volume of the piece. There are three types of pores: open, closed, and closed at one end. Obviously, the only passage *through* the medium is via the open pores. Therefore, if the flow of air or gas through the medium is to be uniform, it is essential that the medium's pores be uniformly distributed.

Norton, long-experienced in the development of fused alumina products, meets this need with porous mediums of ALUNDUM material. Thanks to "controlled structure" processing, all Norton ALUNDUM porous mediums have substantially the same pore volume — while the size and number of open pores are varied to provide the desired permeability.

### *Other Advantages*

ALUNDUM porous mediums are unaffected by acid, neutral or slightly alkaline conditions encountered in commercial and laboratory processes . . . they are exceedingly refractory, withstanding temperatures up to 1000° C . . . their unusual strength assures maximum resistance to abrasion, high operating pressures and breakage or chipping in handling.

### *Send For Bulletin*

Bulletin No. 140 contains complete data as to physical structure, etc., of Norton ALUNDUM porous mediums, and other refractory products. Let it help you decide whether they will benefit your processing. Your Norton representative will be glad to supply you with a copy, or write direct. Norton Company, 597 New Bond St., Worcester 6, Mass.

NORTON

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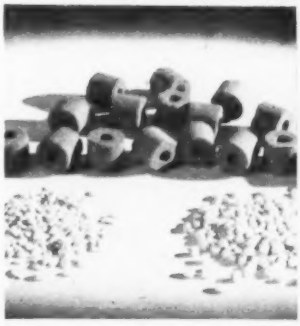
*Making better products to make other products better*

## *POROUS MEDIUMS*

Canadian Representative
A. P. GREEN FIRE BRICK CO., Ltd. TORONTO, ONTARIO

## *Fused Alumina Catalyst Supports In Wide Choice Of Surface Areas*



Norton Company is now making catalyst supports in commercial quantities, in five different mixtures of refractory grains, ranging from 77% to 89% fused alumina. Water absorption values of these catalyst supports vary from 12% to 22% by weight, while surface areas by the nitrogen absorption method range from 0.025 to 0.821 square meters per gram. They are made in spheres, pellets and rings of varying sizes.

### *Get All The Facts*

Your Norton representative will be glad to give you full information about these new catalyst supports. Or, a letter direct to us will get prompt attention.

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No other floating roof gives you . . .

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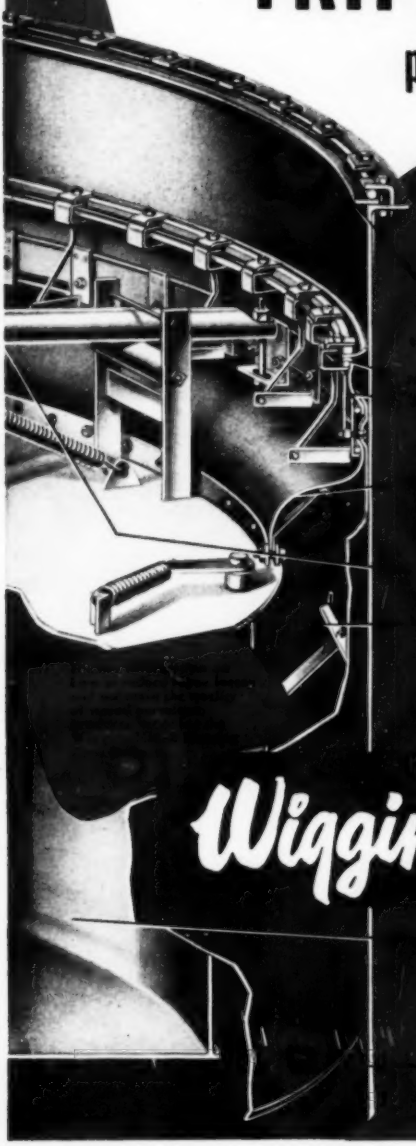

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Covering petroleum research and the design, management, operation and maintenance of plants processing hydrocarbon materials into fuels, lubricants and chemicals

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Published second Tuesday of each month by National Petroleum Publishing Co., 1213 West Third St., Cleveland 13, Ohio. Subscriptions: $8.00 a year in U.S. and possessions, $8.50 a year elsewhere. Single copies, 75 cents each; back copies more than three months old, $1.00 each. Microfilm copies available through University Microfilms, Ann Arbor, Mich. *Petroleum Processing* is indexed regularly in Industrial Arts Index, Engineering Index and Chemical Abstracts. Published prior to Sept., 1946, as the *Technical Section of National Petroleum News*, devoted to Refinery Management and Petroleum Chemical Technology, and including *International Petroleum Technology*. Trade mark registered U.S. Patent Office. Copyright 1951 by National Petroleum Publishing Co. Acceptance under the act of June 5, 1934, at Cleveland, Ohio, authorized Dec. 22, 1948.

*Other Platt Petroleum Publications*

**Platt's Oilgram News and Platt's Oilgram Prices**

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**National Petroleum News**

The weekly oil marketing magazine, covering news prices, transportation, storage, merchandising

October, 1951
Vol. 6, No. 10

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# WELDING FITTINGS ON YOUR MIND

**It will pay you to think of Midwest whenever you think of welding fittings. For example: the variety of elbows offered only by Midwest provides greater latitude in piping design and permits improvements and economies not otherwise possible.**

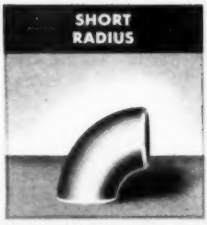
**MIDWEST "LONG TANGENT"**

Same radius as ASA but tangent equal to 25% of nominal pipe size on each end. Saves pipe, layout and welding time. Costs no more than ASA. Sizes to 24".

**ASA STANDARD**

Dimensions conform to applicable size range of American Standard for Butt-Welding Fittings, ASA B16.9. Tolerances much less than allowable. Sizes to 26".

**SHORT RADIUS**



Recommended where space limitations do not permit use of "Long Tangent" or ASA Elbows. Sizes to 30".

**MIDWEST REDUCING**

Takes the place of a straight size elbow and a reducer. Eliminates one weld, reduces pressure drop, easier to insulate. Sizes to 12", reductions to half size.

4580

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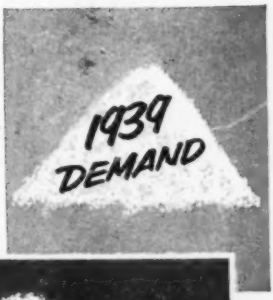
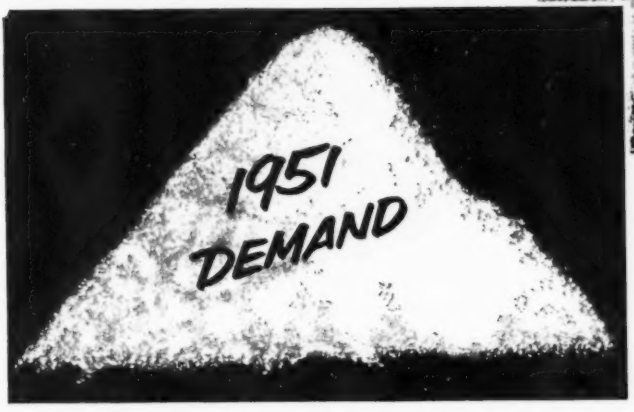
## In spite of record output

# Sulphur is SHORT






**For the first time since World War I, sulphur is in short supply . . . a condition which promises to continue and to affect the products of many industries.**

## Commercial sulphur in quantity is just one advantage of this method for removing $H_2S$

SULPHUR IS A MARKETABLE and profitable side-product of the Shell Phosphate Process for dependable, low-cost removal of $H_2S$ in the presence of large volumes of $CO_2$. Since the recovered $H_2S$ is of relatively high concentration, it can be converted to solid sulphur or acid at very low cost.

This treating process has no harmful effect upon subsequent refining operations. The treating agent is inorganic . . . non-contaminating to hydrocarbons.

The Shell Phosphate Process is outstanding for its low operating costs. All but harmless amounts of $H_2S$ are removed while most of the $CO_2$ is left untouched.

**The Shell Phosphate Process is available to any operator under license from the Shell Development Company . . . together with experienced engineering service for its design, and operation.**

**SHELL DEVELOPMENT COMPANY**
**50 WEST 50TH STREET • NEW YORK 20, N. Y.**

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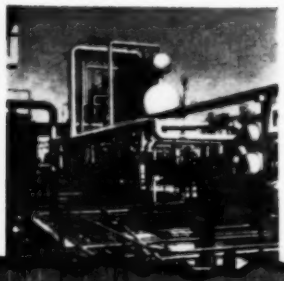
WORLD PETROLEUM

# 22 New Alkylation Units Planned



***Petroleum Administration for Defense approves accelerated amortization for alkylation plants to cost $36 million.***

ALKYLATION is currently regaining a major resurgence as a result of both increased military requirements, and the challenge of the high compression ratio automotive engine. This is apparent not only in announcements of new plant construction but even more dramatically in a recent tabulation issued by the Petroleum Administration for Defense in which the PAD lists applications for accelerated amortization. These, including facilities for basic refining, alkylating, production of aromatics and other refining and petrochemical operations, amount to more than half a billion dollars.

Over seven percent of this total will go for 22 alkylation plants and supporting facilities. A large proportion of the proposed increase in capacity can be laid directly at the feet of the aviation industry which has produced the powerful reciprocating engines that require 115/145 grade avgas rather than the 100/130 grade used during World War II.

To produce this grade not only calls for high quality alkylate but also greater production because the problem is further compounded by the fact that today's engines require a blend of which approximately 85 percent may be alkylate, the remainder being largely composed of isopentane and aromatics. This is more than double the 35 percent alkylate content needed in World War II.

Thus, with [illegible] more gas produced


The Cameron

NON-LUBRICATED

LIFT-PLUG VALVE

*- designed especially for alkylation service*

**This is the valve that was developed expressly for HF and $H_2SO_4$ Alkylation service. Its performance in this difficult service has been so outstanding that it is now being widely used wherever corrosion, elevated temperatures or high pressures are factors.**

**The seat, which is separate from, and not attached to, the valve body, may be readily replaced without removing the valve from the line. Obviously, the seat and plug may be had in any desired alloy for special service conditions. The non-lubrication feature eliminates the bother and expense that goes with lubricated valves, and prevents product contamination. The valve operates with remarkable ease and seals tightly without the aid of lubricant.**

Cameron IRON WORKS, INC.

P. O. BOX 1212, HOUSTON, TEXAS

Export: 74 Trinity Place, New York, N. Y. Represented in the sterling area by: British Oilfield Equipment Co., Ltd., Duke's Court, St. James's, London S.W.1, Eng.

# WHAT'S HAPPENING

**Current News Summarized For Oil Men**

## Expansion

**Refinery expansion projects recommended by PAD** to the Defense Production Administration call for about $1 billion capital investment, according to C. E. Davis, Refining Division director. These projects, after adjustments for probable cancellations, provide for expansion in processing capacity as follows:

| | |
|---|---|
| Charging capacity in b/d: | |
| Crude distillation | 1,013,000 |
| Catalytic cracking | 750,000 |
| Catalytic reforming | 190,000 |
| Catalytic polymerization | 13,000 |
| Productive capacity in b/d: | |
| Aviation alkylate | 50,000 |
| Benzene | 8,000 |
| Toluene and aromatic aviation base | 20,000 |

**Expansion applications now on file with PAD** are sufficient to boost nation's refining capacity by about 1,400,000 b/d—or 400,000 b/d above present expansion goal. Any project approvals in excess of the 1,000,000 b/d goal will have to await an upward revision of that goal—which is expected shortly.

**Lube oil capacity expansion** to the extent of 15,000 b/d of high VI oils and 8-million lbs./month of detergent-type lube additives is being sought by PAD. Agency is preparing to ask formal Defense Production Administration approval of such a program, which would make projects eligible for accelerated tax amortization and also put them in a more secure position to get priorities aid on materials.

**Pan-Am Southern Corp.** has let contract to Lummus Co. for building a new coking unit at its Destrehan, La., refinery. Unit will charge about 9,000 b/d of heavy bottoms, and turn out over 300 tons of coke daily plus gas oil for catalytic cracking feed stock. Pan-Am Southern is already building catalytic reforming, cracking and alkylation units at Destrehan.

**Sunray Oil Corp.** will build a completely new 25,000 b/d refinery near Corpus Christi, Texas. Process units will include Fluid catalytic cracking and HF alkylation, with Universal Oil Products Co. doing design work. Total gasoline yield from plant will be an estimated 56%—as compared with a present average for all U. S. refineries of less than 44%.

**California Standard** is contemplating further expansion in Utah. Company is presently spending $5- to $7-million in the state for oil exploration—and if it pays off may double the capacity of the 25,000 b/d refinery there of Salt Lake Refining Co., its subsidiary.

**Deep Rock Oil Corp.** has scheduled immediate start on construction of a new blending and packaging plant for motor oils and greases at its Cushing, Okla., refinery. Plant will have a capacity of six million gals. annually, and is slated to be in operation late this year. Chemical Plants Division of Blaw-Knox Construction Co. has contract.

**Saskatchewan Federated Cooperatives, Ltd.,** has more than doubled previous capacity of its refinery at Regina, Sask., which is now charging an average of 6,000 b/d as result of new units recently installed.

## Foreign

**Standard Vacuum Oil Co.** will build a new 15,600 b/d refinery at Durban, S. Africa, instead of the 10,000 installation previously planned (see What's Happening, July, p. 691). Plant will now cost an estimated $17-million, and is expected to go on stream in late 1953 or early 1954. Foster Wheeler has contract.

## Petrochemicals

**Alamo Chemical Co.** has been incorporated by Phillips Chemical Co., General Aniline & Film Co. and Borden Co. Plans now in "purely conversational stage" are to build a plant on Texas Gulf Coast to make anhydrous ammonia, methanol and acetylene. Phillips has obtained DPA certificate of necessity for such a project with an estimated investment of $38,260,000.

**Indiana Standard** has started construction on a plant to recover 55 tons per day of elemental sulfur from refinery gases produced in its Whiting, Ind., refinery. Construction contract has been awarded to Fluor Corp., and completion is expected in mid-1952.

**Ethyl chloride production capacity** will be "nearly doubled" by Shell Chemical Corp. through additions planned for its Houston plant. Construction is expected to be completed by early 1953.

## Markets, Prices

**There was no appreciable easing of prices** for distillate fuels in principal supply markets in September, despite a further sharp rise in the nation's fuel inventories of these products—approximately 10,000,000 bbls. in the 4-week period ended Sept. 22. And gasoline, plagued with retail price wars at scattered points throughout the country east of the Rockies, failed to budge from its firm price position at the primary supply level.

**Substantial export purchases by Asiatic Petroleum Corp.** to supplant production lost at Anglo-Iranian's

*Information on these pages is obtained through the nation-wide news coverage service of* PLATT'S OILGRAM NEWS

refinery in Abadan were generally pointed to by trade sources as the principal factor bolstering U.S. distillate and gasoline prices. As of Sept. 27, Asiatic had bought a total of 25,996,000 bbls. of refined products in this country since July 1 for export prior to Jan. 1, 1952. Of this total, 9,970,000 bbls. were kerosine and No. 2 gas oil, and 8,230,000 bbls. were gasoline (aviation and motor).

**Anticipating the big consuming season just ahead,** refiners and terminal operators in most areas continued reluctant to offer heating oils to other than their regular customers. In some instances, notably in the Chicago District, there was some "forced" selling at "shaded prices" to make room for incoming barge shipments. But, generally speaking, the distillate price structure remained firm.

**Worst of the retail gasoline price wars** was at Philadelphia where, as this is being written, price for regular-grade motor fuel at one major brand station had dropped to 10.4c per gal. (ex 6.5c state and federal taxes). Retail postings of 11.4c and 12.4c were predominant at other outlets in the city.

**Highlight of the month pricewise** was an increase of 0.875c, from 5.5c to 6.375c per gal., in Group 3 price for Grade 26-70 natural gasoline. Wax continued soft, although there was no further decline from price of 5.125c per lb. for crude scale in Western Penna. Neutral oils were a shade easier in both Western Penna. and the Mid-Continent; prices, however, were unchanged.

## Industrial Mobilization

**Structural steel allotment to refining branch** of oil industry for planned expansion in fourth quarter was cut from an estimated requirement of 29,000 tons to only 18,000 tons by DPA. Natural gas processing branch was allotted only 6,000 tons, as against an estimated requirement of 12,818 tons.

**Slight relief in tetraethyl lead situation** is seen in National Production Authority's notice to TEL manufacturers that their October quotas of metallic lead will be slightly higher than in September—which were cut to about half of what had been requested.

**Petroleum-butadiene for synthetic rubber** is favored over alcohol-butadiene by Senate Preparedness Subcommittee. In its third report on rubber, issued last month, subcommittee pointed out that if the more costly alcohol-butadiene is used for a proposed 100,000 tons per year expansion in GR-S capacity, the ultimate competitive position of synthetic as against natural rubber would be adversely affected. On the other hand, it was noted that construction of 75,000 tons per year of petroleum-butadiene facilities would require about 18 months and $85,000,000.

**Esso Standard Oil Co.** has contracted to buy a 50-acre site in New Jersey, about 35 miles from New York City, for possible emergency headquarters of the company and its affiliates.

**APPOINTMENTS—Roy P. Wilson** (Sinclair, and formerly chief of Refining Materials Branch of PAD's Materials Division) as chief of Refining Projects Branch in Refining Division . . . **Rolland P. Wood** (Pure, and formerly chief of Marketing Materials Branch in Materials Division) to replace Wilson as chief of Refining Materials Branch . . . **Lawrence Lee** (vice president of refining and marketing for Husky Oil Co.) as first director of PAD's Distribution and Marketing Division . . . **Elmer Batzell** (formerly PAD Finance Counselor) as Asst. Deputy Administrator and General Counsel, replacing **Justin R. Wolf,** resigned.

## Synthetic Fuels

**Interior Department's ambitious plans** to underwrite a $455-million venture into commercial production of synthetic liquid fuels (see Sept. What's Happening, p. 932) may have been stymied for time being by Defense Production Administration. DPA has called on Interior to furnish a minute "bill of particulars" as supporting data for request to DPA for government backing of a 30,000 b/d coal hydrogenation plant and a 10,000 b/d shale oil facility. This bill of particulars may be beyond Interior's ability to fill at this time.

**Only half the steel and half the money** would be required to obtain from petroleum the same quantity of gasoline and other fuels that would be produced in the $400-million 30,000 b/d coal hydrogenation plant which the Interior Department wants to see built, according to Robert E. Wilson, Indiana Standard board chairman.

**Price ceilings for high octane gasoline** made from natural gas by Carthage Hydrocol at Brownsville have been set by Office of Price Stabilization—an indication the plant may be nearing full production. Price set for 94-octane, 9.5 lb. RVP, FOB seller's dock, Brownsville is 15.05c per gal., with a sliding scale allowing for fluctuations of 0.25c per octane number and 0.2c for each pound RVP.

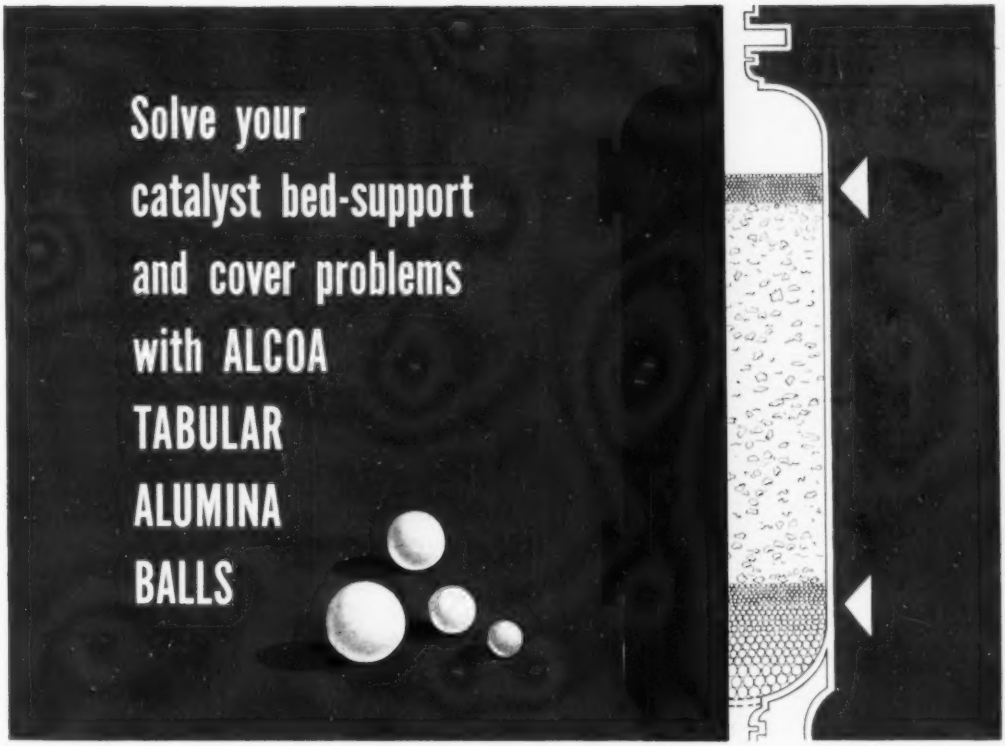
## Miscellany

**An avgas additive to reduce spark plug fouling** has been developed in Shell Oil's research laboratory at Wood River, Ill. Although the identity of the additive has not been disclosed, it is said to reduce fouling by changing the nature of deposits which accumulate on plugs so that they are non-conductive and cannot short circuit plug. Product is still under evaluation.

**Twelve persons were killed, 18 injured seriously** in an explosion and fire at Shell's Wood River, Ill., refinery Sept. 17. Cause of explosion has not been set. Night crew was bringing down a Dubbs cracking unit for routine cleanup when there was a sudden flash, followed by explosion and fire. Cracker was not damaged seriously, and blaze was brought under control in about 20 minutes.

**James Boyd reportedly has resigned** as director of U.S. Bureau of Mines, in aftermath of row which saw him incurring high disfavor at Interior Department for refusing to go along with plans to launch government-subsidized production of synthetic liquid fuels. It was reported also that he will become a vice president of Kennecott Copper Co. on leaving B of M.

# Solve your catalyst bed-support and cover problems with ALCOA TABULAR ALUMINA BALLS



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**Higher Efficiency . . . Better Operation . . .**

—The stream is evenly diffused across the catalyst bed . . . Resistance to stream flow is reduced.

—Ceramic balls replace fine mesh inside screens.

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—High resistance to abrasion, mechanical shock and thermal shock . . . Can withstand sudden temperature changes of more than 1000° C. (1832° F.).

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—Any depth of bed-support and cover can be used . . . Five sizes of balls—from ¼" to ¾"—permit a selection best suited to your process.

In addition to their uses as bed-supports and covers, ALCOA Tabular Alumina Balls also offer you money-saving advantages when used as a heat-exchange medium. They have both high heat capacity and high heat conductivity.

*Specific heat (at 1000° C.) = 0.3 cal./g./°C.*
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ALCOA Tabular Alumina Balls may help solve a difficult problem. Let us tell you more about this unique form of alumina. Write to: ALUMINUM COMPANY OF AMERICA, CHEMICALS DIVISION, 616K Gulf Building, Pittsburgh 19, Pennsylvania.

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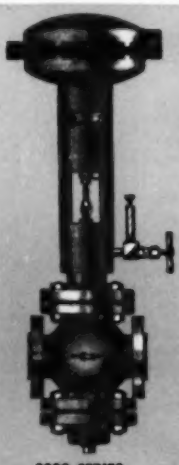
**Size range from ½" thru 12" ($C_v$: 0.001 — 1440) will accurately control extremes in flow, temperature and pressure on air, water, steam, oil or gas service.**



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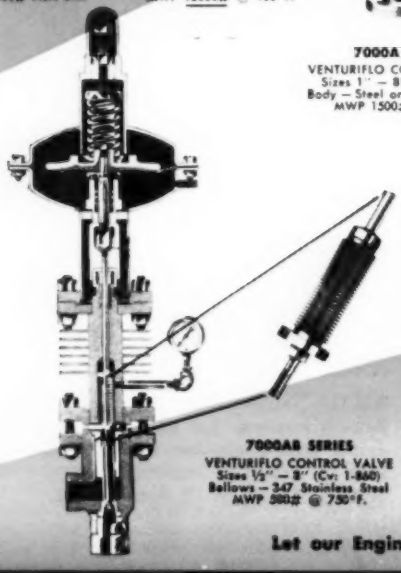

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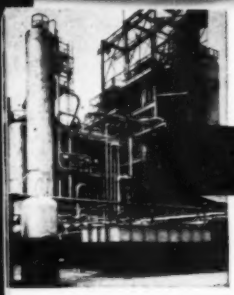


# TOMORROW... IN PETROLEUM TECHNOLOGY

**Possible Effects of Today's Developments On Future Operations**

*By the Editors of Petroleum Processing*

## A Look Ahead in Petroleum Refining

This month the regular department "Tomorrow in Petroleum Technology," is given over to reports on some of the paper presented at the Symposium on Twenty-Five Years Progress in Petroleum Technology. The symposium was held by the Petroleum Chemistry Division of the American Chemical Society in New York, Sept. 6-7, in connection with the Diamond Jubilee meeting of the ACS. The review reports, with the comments of their authors, in many instances point out significant economic and technological trends which developments in petroleum refining in future years may be expected to follow. Thus discussion of the papers is appropriately within the scope of the "Tomorrow in Petroleum Technology" section.—V.B.G

## Wider Applications of Catalytic Cracking

CATALYTIC cracking units of the future will be more closely integrated in the refinery's processing sequence and will have greater flexibility in their charge stocks, it was brought out at the meeting in New York, Sept. 6-7, of the Petroleum Chemistry Division of the ACS. These developments will be achieved both through new design and engineering features of the cracking units and through improved and new types of solid catalysts.

A new design development of the Fluid catalytic cracking process already incorporated in new commercial units now being installed "involves the integration of the Fluid cracking plant with crude distillation, naphtha reforming and light ends processing."[1] This combination unit offers a reduction in refinery handling losses, lower personnel requirements and substantial economies in fuel, steam and cooling water requirements.

While no details were given on the new design it was stated: "The combination units can be designed advantageously in size from 2000 to 60,000 b/d of crude, but are particularly suited for the small refiner. Engineering studies indicate that in the Gulf Coast area such a design results in an investment saving of 30 to 40% over a conventional refinery. Studies have also shown that a 10,000 b/d refinery using this development could manufacture products as economically as a 50,000 b/d refinery having a conventional processing sequence."

The experience obtained from increasing the capacity and improving operations of existing Fluid units has been incorporated in the current designs being offered by various engineering companies. The saving in investment due to the simplified design is estimated at about 25% over the earlier designs. Process and mechanical improvements have also reduced operating costs.

Fluid cracking of reduced crude has been demonstrated in both pilot and commercial Fluid units. "Although the results obtained are reasonably attractive, this operation has been used commercially only in isolated cases, as most refineries dispose of residual fuel oil fractions in other ways."

Among a wide variety of miscellaneous refinery streams that have been profitably processed in Fluid units are; thermal and catalytic cycle stocks, phenol plant extract, sulfur dioxide plant extract, petrolatum, slop and separator oils. Virgin or cracked naphthas can also be processed. "The Fluid process for improving virgin naphthas, however, is not widely used commercially, because processes such as thermal reforming or hydroforming are more attractive."

In the improved Houdriflow units, the availability of large quantities of heat in the reactor has further increased the flexibility of this process with regard to charge stock boiling range.[2] The mechanics of handling nonvaporizable stocks were improved through the development of a feed nozzle which could handle mixed-phase charge. This eliminated the need for a tar separator in some cases and for a recycle feed heater, so that the feed preparation section was also considerably simplified.

The pneumatic lift, in addition to being able to handle large quantities of catalyst, is very flexible with respect to catalyst circulation. "Therefore, in a gas lift unit it is entirely practical to adjust catalyst circulation rate as required by other processing considerations."

(1) "Fluid Catalytic Cracking Process," E. V. Murphree, Standard Oil Development Co.
(2) "Catalytic Cracking in Fixed- and Moving-Bed Processes," D. R. Ardern and J. C. Hart, Houdry Process Corp.; R. C. Lassiat, Sun Oil Co.

## Stellar Role for Cracking Catalysts

AUTHORITIES in the catalytic cracking field foresee future improvements through work on the catalysts used, as well as in the design and engineering changes in the basic design of the processing units.

In spite of outstanding mechanical and processing improvements, it was brought out in discussions of the Houdriflow and Thermofor air lift processes,[1] proportionately fewer advances have been made in the development of cracking catalysts. Some new catalysts have given somewhat better product distribution from distillate stocks but at some sacrifice in octane number of the catalytic gasoline.

"The prospects for improvements in the moving-bed catalytic cracking process appear to be in the direction of improved catalysts which provide increased yields of gasoline for a given yield of coke and have higher regeneration rates and greater chemical and physical stability."

Possibilities for developing sulfur-resistant catalysts are seen by the same authorities, since the synthetic catalysts have been shown to be more stable

with sulfur charge stocks than natural clay catalysts. Certain types of iron-free catalysts and bentonitic clays treated to remove iron do not show sulfur deactivation.

"The problem of adapting clay catalyst to high-sulfur stocks was solved through the relatively simple expedient of prehydrating the regenerated catalyst before it came in contact with the oil vapor. Selective adsorption of steam has the effect of protecting the catalyst from the action of the sulfur compounds. The sensitivity of clay catalyst to sulfur poisoning has been attributed to traces of iron present in the catalyst which, in combination with the sulfur, produces uneconomically high yields of coke and gas. Specially treated clays and certain naturally occurring iron-free clays are resistant to sulfur poisoning without any special hydration."

Three types of catalyst have been used in commercial Fluid operation, synthetic silica-alumina, activated natural clays and synthetic silica-magnesia.[2] The choice depends on the product yield and quality requirements in the individual situation. Comparative yield data indicate that the catalyst giving the higher gasoline yields simultaneously produces a gasoline of lower octane number. The natural clay catalyst gives results intermediate to the two synthetics; silica-alumina gives the highest octane number and silica-magnesia gives the highest gasoline yield.

"Because catalysts play an important role in the catalytic cracking process, further and new developments in this field may be expected".

(1) "Catalytic Cracking in Fixed- and Moving-Bed Processes." D. B. Ardern and J. C. Dart, Houdry Process Corp.; R. C. Lassiat, Sun Oil Co.
(2) "Fluid Catalytic Cracking Process." E. V. Murphree, Standard Oil Development Co.

## Economies in Catalytic Reforming

DEVELOPMENT work with the Fluid hydroforming process has already reached the point where the investment cost for commercial units is as low, or lower, than for conventional thermal reforming and catalytic polymerization.[1] Also, improved yields and high octane numbers for motor gasoline can be attained.

Investigators for M. W. Kellogg Co., on the basis of their work on a 3 b/d pilot plant, presented an economic balance sheet for a 7500 b/d Fluid hydroforming unit, employing an East Coast construction, operating cost and price structure. (Table 1) The feed stock has an ASTM boiling range of 204/373° F., a 56.1 API gravity, 138° F. aniline point and Research octane number of 39.1. The economics indicate a pay-out time of about one year for the investment cost of $2,250,000.

**TABLE 1—Economic Balance Sheet for Fluid Hydroforming of 204/373° F. Mid-Continent Naphtha**

(Production of 10-lb. RVP gasoline of 95 octane (CFRR + 3 ml. TEL/gal.); 7500 b/d unit; East Coast price structure)

| | b/d | cost/day, $ | |
|---|---|---|---|
| **Credits:** | | | |
| 10-lb. RVP gasoline | 6,800 | $34,800 | |
| Fuel gas (fuel oil equivalent) | 803 | 1,525 | |
| Total credits | | | $36,325 |
| **Debits:** | | | |
| **Stock cost:** | | | |
| Naphtha | 7,500 | 25,200 | |
| Extra butanes | 300 | 726 | |
| Direct Operating Cost: | | | |
| Total process cost | | 1,868 | |
| Ethylizing, 0.2c/ml TEL/gal. | | 1,713 | |
| Taxes, insurance (2% of investment) | | 123 | |
| Royalties, 7c/bbl. | | 462 | |
| Total debits (before depreciation) | | | 30,092 |
| **Credit less debits** (before depreciation) | | | 6,233 |
| **Investment** | | | $2,250,000 |
| **Pay-out time, years** | | | 0.99 |

(1) "Intermittent and Fluid Catalytic Reforming of Naphthas." Henry G. McGrath and Luther R. Hill, M. W. Kellogg Co.
(2) "Fluid Hydroforming." E. V. Murphree, Standard Oil Development Co.
(3) "Comparison of Platforming and Thermal Reforming." Vladimir Haensel and Melvin J. Sterba, Universal Oil Products Co.

In their discussion of catalytic reforming of naphthas these authors concluded: "The general use of automotive engines now being marketed with compression ratios higher than 7 or 8 to 1 awaits the widespread production of motor fuels on the order of 95 CFRR octane clear. The Fluid catalyst hydroforming process is capable of meeting this challenge."

The early work on the Fluid hydroforming process by the Standard Oil Development Co., which was done on a 4 b/d pilot plant unit, is now being supplemented by that on a 50 b/d large scale Fluid hydroforming plant recently placed in operation at the Esso laboratories at Baton Rouge, La.[2] "Figures which the SOD has prepared indicate that investments for the Fluid hydroforming route are considerably below those for thermal reforming, particularly when the investment for loss in gasoline capacity through thermal reforming is taken into account at higher octane levels."

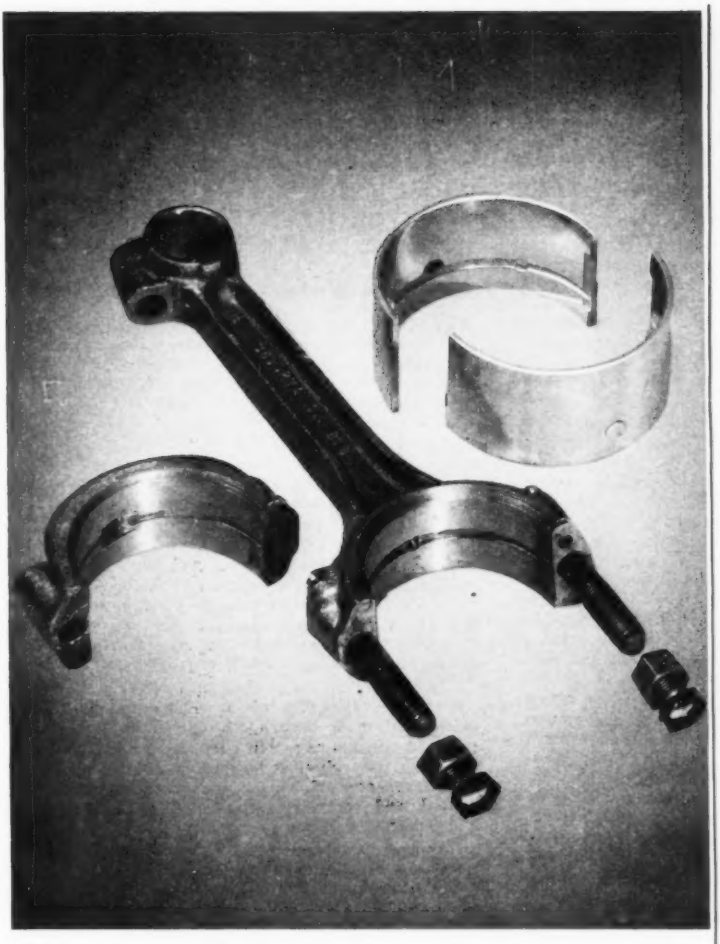
A comparison was reported, as made by the Universal Oil Products Co. research staff, of Platforming and thermal reforming from the standpoint of yield-octane number relationships, product properties, hydrocarbon types, and with respect to the nature of chemical reactions responsible for improvement of octane number.[3]

At a leaded Research number of 91 the Platforming yield was found to exceed the thermal reforming yield by about 27% of charge, while it exceeded the thermal reforming plus polymerization yield by about 13% based on the charge. The lead susceptibility of Platformates was better than that of olefinic thermal reformates, the difference becoming greater as the octane number level increased. At a given octane number the concentration of aromatics in Platformates is greater than in thermal reformates.

## New Reforming Catalysts Developed

BRINGING to the stage of commercial development the various catalytic reforming processes, both fixed-bed and moving-bed, has of necessity been accompanied by the work of finding suitable catalysts for these operations.

Over the past several years, as reported to the ACS in New York, investigators for the Atlantic Refining Co.[1] have developed a reforming catalyst which simultaneously isomerizes, dehydrogenates and cracks. While the early hydroforming catalysts were recognized as a big step forward in directing the chemical reactions of reforming to the desired end—namely the formation of aromatics—their shortcomings were evident. They required frequent regeneration and they fell short in octane number improvement due to a lack of isomerization ability. The ability of a cat-



# New look for old bearings

Santolube 394-C and Santolube 395-X are Monsanto's corrosion inhibitors and anti-oxidants which, added to suitable base stocks, produce motor oils that protect hard alloy bearings and keep them looking like new.

These additives improve lubricant stability and engine performance by minimizing lubricant oxidation, acid formation and sludge and varnish deposits, and by inhibiting bearing corrosion and lubricant thickening.

**SANTOLUBE 394-C,** with suitable base oils, may be used alone to compound premium-type lubricants, or it may be combined with detergent-dispersant additives, such as Santolubes 203-A, 303-A and 520, in proper oils, to get "Premium," "Medium Duty" and "Heavy Duty" lubricants.

**SANTOLUBE 395-X** was designed primarily for compounding "Premium" motor oils. It also may be used in combination with detergent-dispersant additives to make "Medium Duty" and "Heavy Duty" oils.

Both additives can be blended by using conventional equipment and methods. For further information, write MONSANTO CHEMICAL COMPANY, Organic Chemicals Division, 1700 South Second Street, St. Louis 4, Missouri.

**SANTOLUBE 394-C**
**(Typical Inspection Values)**

| | |
|---|---|
| Specific Gravity at 60° 60° F. | 1.02 |
| Viscosity S.U.S. at 210° F. | 90 |
| S.U.S. at 100° F. | 2850 |
| Flash Point °F. | 200 |
| Color ASTM (diluted) | 3 |
| % Phosphorus | 4.7 |
| % Sulfur | 13.0 |

**SANTOLUBE 395-X**
**(Typical Inspection Values)**

| | |
|---|---|
| Specific Gravity at 60° 60° F. | 1.01 |
| Viscosity S.U.S. at 210° F. | 85 |
| S.U.S. at 100° F. | 1675 |
| Flash Point °F. | 230 |
| Color ASTM (diluted) | 5 |
| % Phosphorus | 3.8 |
| % Sulfur | 10.7 |
| % Barium | 1.0 |

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**Gear-lubricant additive to meet requirements of Federal specification VV-L-761**
**SANTOPOID* S**

**Gear-lubricant additives to meet requirements of military specification MIL-L-2105**
**SANTOPOID 29, 32, 33**

**Motor-oil detergents**
**SANTOLUBE 203-A, 303-A, 520**

**Corrosion inhibitor for distillate fuels**
**SANTOLENE* C**

**Sludge inhibitor for domestic fuel oils**
**SANTOLENE E**

**Cutting-oil additive**
**SANTOLUBE 52**

**Inhibitor-detergent combinations for premium and heavy-duty service**
**SANTOLUBE 205, 206, 360, 374, 379, 388, 521, 522**

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alyst to promote isomerization plays two roles in reforming: It increases the amount of branched chain paraffins in the product and it converts naphthene hydrocarbons with cyclopentane rings into cyclohexane ring naphthenes which are necessary to the formation of aromatics by hydrogenation.

Several years ago an Atlantic Refining investigator found that nickel, platinum and some other hydrogenating agents, when deposited on fresh synthetic silica-alumina cracking catalyst, made a new catalyst that would isomerize paraffin and naphthene hydrocarbons in the presence of hydrogen at elevated pressures and nominal temperatures.

Platinum was found to be the most efficient hydrogenating component for the isomerization catalyst from the standpoint of amount required and resistance to sulfur poisoning. From this beginning an extensive study was made of the isomerization of normal heptane with platinum on silica-alumina catalysts. If this catalyst were to be used at temperatures of 850-950° F., severe cracking of the paraffin hydrocarbons would occur. Hence the problem became one of decreasing the cracking activity of the catalyst without harming its isomerization ability. This was accomplished by reducing the surface area of the silica-alumina component prior to platinization by treating it with superheated steam. "By establishing through the catalyst selection the proper balance and direction of the main reforming reactions—isomerization, dehydrogenation and hydrocracking—a greatly improved efficiency for octane improvement has been achieved."

In the operation of a hydroforming process which permits continuous operation, the use of a powdered or "fluid" catalyst is necessary.[2] The catalyst used in the Kellogg pilot plant work in the Fluid hydroforming field was a molybdena-alumina catalyst (Kellogg $MoO_3$ on $Al_2O_3$ gel) substantially the same as is used in commercial fixed-bed hydroforming.

The early work with a molybdena-alumina catalyst in fixed bed hydroforming was disappointing. Its life was short and selectivity declined. "Laboratory investigation revealed that sodium, which was present in the support to the extent of several tenths of 1% had a profound effect on stability and activity of the molybdena-alumina catalyst. Over a period of time it was possible to alter the procedure for preparing the support on successive occasions until the catalyst contained much less than 0.1% of sodium oxide. The reduction in sodium content of the support was immediately reflected in improved catalyst life. Ultimately, the life was extended to 9 to 12 months before replacement.

"Various forms of alumina have been used as support, including alumina gel and a stabilized alumina gel . . . . Today the majority of refiners who operate hydroformers are using molybdena on alumina gel as a catalyst. The molybdicoxide content of the catalyst is somewhat below 10%. Although similar to the original catalyst as far as chemical composition is concerned, it possesses superior activity and life."

(1) "Development of a Reforming Catalyst", M. J. Fowle, R. D. Bent, F. G. Ciapetta, P. M. Pitts and L. N. Leum, Atlantic Refining Co.
(2) "Intermittent and Fluid Catalytic Reforming of Naphthas", Henry J. McGrath and Luther R. Hill, M. W. Kellogg Co.

## Symposium Papers Published in Book

The collection of 31 papers presented at the Symposium on 25 Years Progress in Petroleum Technology, of the ACS Petroleum Chemistry Division, has been published by the Society under the title "Progress in Petroleum Technology," as No. 5 of its Advances in Chemistry Series.

The book, which is valuable as a reference, as a refresher and as a training manual for new technological personnel, is available through the American Chemical Society, 1155 Sixteenth St., Washington, D. C., for $3.00 a copy, paper bound.

## *Refineries Without Fractionation Towers*

WHILE great improvements have taken place in conventional fractionation equipment since the direct-fired horizontal stills of early days, future developments may bring radical changes in fundamental design.[1] The major advance of the future in distillation may well be the application of centrifugal principles to overcome the limitations interposed by gravity on the mass rate of contacting vapor and liquid, thus permitting higher vapor and liquid velocities in a correspondingly smaller unit.

"Commercial operations using molecular distillation are not now employed by the petroleum industry, but this method has had extensive application in the distillation of fish and vegatable oils for the production of vitamin concentrates. Its great advantage lies in the extremely short residence time at the distillation temperature, an important consideration in processing high boiling or heat-sensitive materials.

"In commercial units the feed stream continuously enters at the apex of a heated wide-angle, cone-shaped plate rotating at high speed. On this rotating cone the feed spreads to a thin film and passes rapidly to the outer rim, where it is continuously removed. The portion evaporated while crossing the rotor is condensed and recovered separately. It is essentially a one-theoretical plate operation.

"Another development that may well influence the science of distillation tomorrow is the rotary column under study by API Project 6 and the Bureau of Standards.

"This unit has a rotor enclosed in a cylinder, with a 1-mm. annular space between the cylinder and the rotor surfaces. The rotor revolves at speeds up to 8000 rpm. and is cooled internally, so that the cold rotor surface acts as a condenser. The shell is heated to cause partial vaporization of the condensate which is thrown from the rotor. Thus, alternate condensation and evaporation take place as the vapor moves up the column. It is claimed that 500 theoretical plates can be developed at a throughput rate of 1 gal. of liquid per hour in a unit having a rotor 5 ft. long and 5 ins. in diameter."

Taking a short look into the future, these authorities find it difficult to envisage further startling developments in conventional petroleum fractionation units. Improvements in bubble cap and bubble plate design will be supplemented by efforts to find methods to replace the bubble cap with more efficient types of contactors. Steps in this direction are the application of Stedman packing, development of the corrugated metal lath tray and the Koch Kascade Tray, which achieve considerable reduction in tower size and initial cost for a given throughput and degree of separation.

(1) "Petroleum Distillation", W. E. Bradley and G. R. Lake, Union Oil Co. of California.

## LETTERS

### Gunite Resists H S

The purpose of this letter is to call your attention to a statement in the article "Fight Corrosion with Plastics" by Messrs. Seymour and Erich. This article was published in the Aug. 1951 issue of PETROLEUM PROCESSING, Vol. 6, No. 8, pp. 861-2. The statement to which reference is made is the last sentence of the second paragraph under "Storage" on pg. 861.

. . . the authors refer to a paper which I wrote and then state that gunite linings are not resistant to hydrogen sulfide; this implies that I stated in my paper that gunite coatings are not resistant to hydrogen sulfide. This is an untrue statement. It is my opinion that hydrogen sulfide has no detrimental effect on gunite; exposures of 8 to 10 years substantiate this opinion.

. . . Gunite linings can and are being used to marked advantage by industry; it is my recommendation that this use be expanded because this is a very effective way to conserve critical materials.

E. Q. CAMP
Humble Oil & Refining Co.
Refining Dept.
Technical and Research Divisions
Maytown, Texas

*When Mr. Camp's letter was brought to the attention of the authors of the article, they replied in part as follows:*

*"We recognize that the various engineers at Humble Oil & Refining Co. have found Gunite to be resistant to hydrogen sulfide. While we respect their judgment, Gunite is often deficient in this respect. It is not generally considered to be resistant to hydrogen sulfide.*

*"We did not intend to attribute the statement that Gunite linings are not resistant to hydrogen sulfide to Mr. Camp, but merely to refer to his description of Gunite linings which he had adequately covered in a previous issue of* PETROLEUM PROCESSING. *We are sorry it might be implied that Mr. Camp considers Gunite not to be resistant to hydrogen sulfide and agree with you that the erroneous impression should be corrected."*

### Atlantic Patent vs. Russia

I have read with great interest the very detailed review of my patent No. 2,550,531 ["Processing Patents," Aug. PP, p. 887], assigned by me to The Atlantic Refining Co. and covering a platinum-containing catalyst for catalytically reforming petroleum hydrocarbons. I think the review was well presented in every respect—with the exception of the final paragraph.

It is obvious that the reviewer examined only the immediate file history in which, admittedly, no Russian references were cited. However, for


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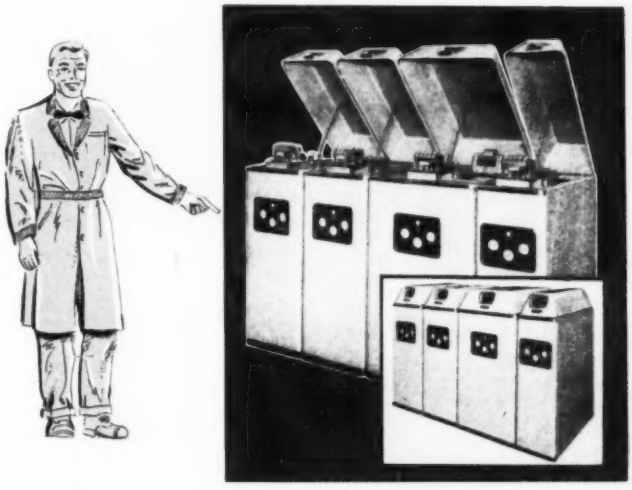

This improved Bowser automatic blender has a simple control on each meter to permit instantaneous setting of ingredient proportions.

It eliminates unnecessary manifolding, double pumping and large storage facilities for blended stocks . . . assures thorough homogenization and uniformity of product. Liquids are blended as needed and go directly to tank cars or containers.

- Blends additives with oil.
- Eliminates oxidation caused by air agitation.
- Blends at operating pressure of processing plant, assuring retention of volatile additives.
- Accurately proportions two or more liquids in percentages as low as 1/2%. Additives or inhibitors can be added in increments from 1/20% to 10% of total blend.
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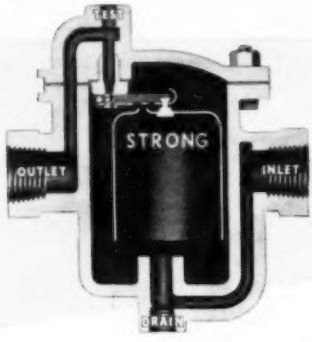
# Get this *SMALL* TRAP

*With*

# *BIG* TRAP quality features!




- Renewable seat—easily removed for servicing.
- Strong's patented, wear-resistant Anum-Melt† valve and seat—guaranteed leak-proof for one year. Scientifically designed Hi-Cap orifice gives greater capacity.
- Oversized ports—increased capacity.
- Horizontal inline connections—simplifies piping.
- Stainless 18-8 high ratio leverage.
- Large gasket area.
- Seamless, deep drawn, stainless 18-8 bucket—no welds.
- Bottom drain or inlet connection.

Available for pressures from 0 to 150 p.s.i., the Strong* No. 070 fits all standard trap applications. Built especially for use on laundry, restaurant and hospital equipment and in industry wherever small drainage is a problem.

As with all Strong Semi-Steel Traps, the 070 is guaranteed against defects in material and workmanship for one year. Write today for Catalog 68-Q.

*T. M. Reg. U. S. Pat. Off.

**STRONG, CARLISLE & HAMMOND COMPANY**

1392 WEST 3rd Street
Cleveland 13, Ohio

† Anum Melt Reg. Trade Mark

Reducing Valve

Blast Trap

"SY" Strainer

STRONG


## Letters

the reviewer's information, there was cited in my application at least one reference which had been allowed by the U. S. Patent Office over certain Russian publications, thus indicated that the Patent Examiner was thoroughly familiar with these publications but did not consider them pertinent to the subject matter described and claimed in my application.

I would like also to mention that prior to the filing of my application, a very thorough search of the patent and literature arts was made, that a number of Russian publications were examined, and that, in my opinion and in the opinion of our Patent Dept., none of these publications were pertinent to the subject matter of my application.


FRANK G. CIAPETTA
Atlantic Refining Co.
Philadelphia, Pa.


*The paragraph in question: "Incidentally, there has been considerable work done in the past, particularly by Russian workers, on the reforming of pure hydrocarbons with platinum and palladium catalysts, and it is surprising that none of these articles was cited by the Patent Office against the application."*

PETROLEUM PROCESSING *regrets any concern these remarks may have caused the Atlantic Refining Co. Patent Reviewer Gaylor explains that "the Patent Office Examiners generally cite references promiscuously, regardless of their relevancy, and this statement was intended merely to substantiate my contention, expressed a number of times, that although the Patent Office makes a fairly good search of the patent art, its searching is poor with respect to the literature."*

### The Ideal Flare

. . . This type of flare ["Smokeless Flare Stack," Sept. PETROLEUM PROCESSING, p. 978] appears to be the simplest and most effective I've seen to date; and the recorded pictures and operating data should permit the refiner to arrive at a reasonable design for his own use. However, I believe two of the most important features of the ideal flare have not been included in the article, namely (1) the development of proven control instrumentation, and (2) determination of the range of gas flows for a given diameter stack over which the flare can be operated without smoke.

Mention of these two items which are not considered in the article is not intended as criticism of the article itself. Rather, they are mentioned to point out that further work is needed in this field to develop a completely satisfactory flare.


H. P. CALDWELL
Socony-Vacuum Laboratories
Paulsboro, N. J.

SERVICE LEDGER
1901-1951

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ARGENTINE MINISTRY OF WAR
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ATOMIC ENERGY COMMISSION
BRITISH AMERICAN OIL CO. LTD.
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D-X

# *Building for product improvement ...with Mid-Continent!*

First order from the Mid Continent Petroleum Corporation, in 1939, was for lube improvement units . . . deasphalting and acid treating. The following year we were busy again, this time in the gasoline end of the operation, engineering and constructing Mid Continent's first catalytic polymerization unit.

As part of its immediate post war operations, Mid-Continent ordered a Kellogg Fluid catalytic cracker to lift the overall refinery octane level . . . and this unit went on stream in 1949. Then just last year Kellogg engineered an alkylation unit for this refiner . . . a unique one inasmuch as it was designed to run in process series with Mid Continent's modernized cat poly unit. This operating technique squeezes the maximum volume of high octane fuels from the gaseous by products of other refinery processes.

## THE M. W. KELLOGG COMPANY

A SUBSIDIARY OF PULLMAN INCORPORATED

*for fifty years an integral part of processing history*

NEW YORK JERSEY CITY LOS ANGELES TULSA HOUSTON TORONTO LONDON PARIS

Portrait at Fifty

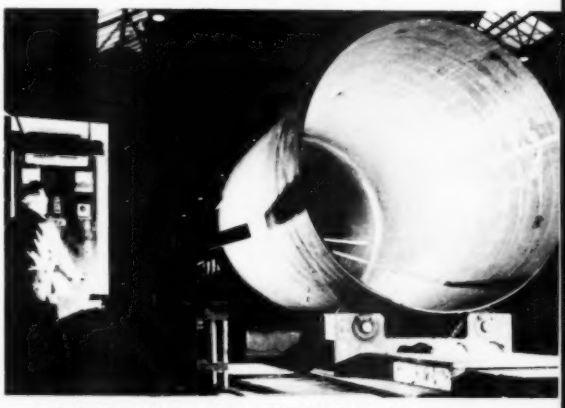
# Portrait at

*This year is Kellogg's fiftieth of service to industry. At this time naturally, as a group of men—known collectively to the modern business world as The M. W. Kellogg Company—we can think back nostalgically. We can remember the chimney stacks*

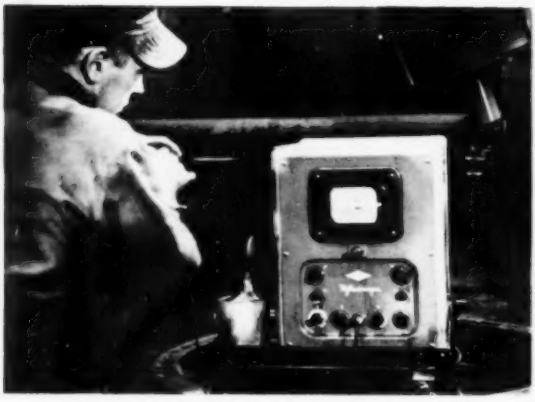
## "Unusual Techniques Set High Quality Level..."

*In previous issues of this magazine, "camera portraits" of M. W. Kellogg today have highlighted major aspects of Kellogg's broad research, development, engineering and procurement activities . . . and introduced readers to the company's fabrication facilities.*

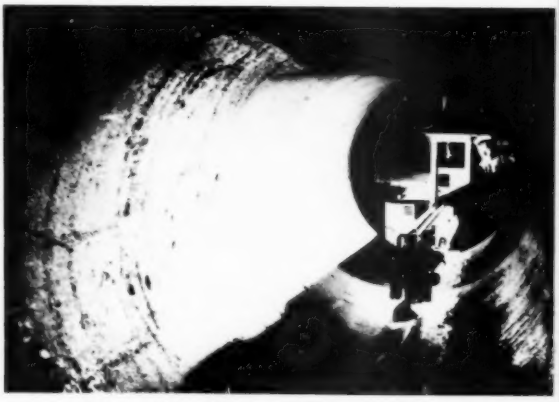
*This month, the camera continues its tour of Kellogg's Jersey City Shops, focusing particularly on some unusual techniques employed by Kellogg to maintain the highest quality in fabricated process piping and equipment.*



1. *OUR COMPANY WAS ONE OF THE FIRST* fabricators to adopt radiography in its Shops as a quality check . . . and early developed one of the most extensive radiographic operations in the industry. Beyond utilizing this method as a positive check on specific jobs, Kellogg employs it to evaluate new welders and also to maintain daily welding operations at a high quality level.



4. *A RECENT INNOVATION* in shop procedure for the fabrication of critical power station piping is the ultra-sonic testing of "race" pipe. Developed in conjunction with a leading turbine manufacturer, this application of a modern testing technique should prevent the costly failures that have occasionally occurred because of internal flaws that cannot be discovered by any other practical method.



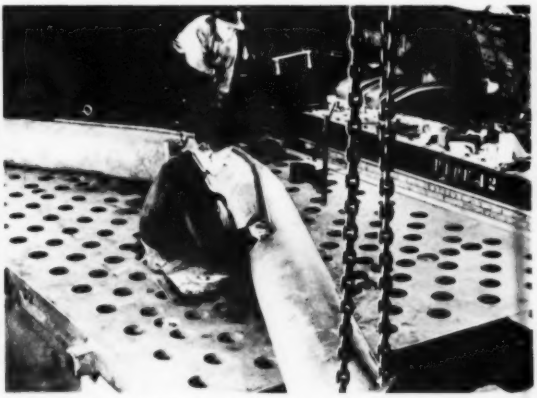
5. *AS FAR AS SIZE IS CONCERNED*, the Shop's facilities for making process piping are virtually unlimited. Pictured is one of industry's first machines for continuous longitudinal welding of the interior of pipe. The use of advanced equipment is typical of Kellogg shops . . . in fact, almost every step in fabrication is accompanied by either exclusive techniques or exclusive equipment.

# Fifty... no. 9

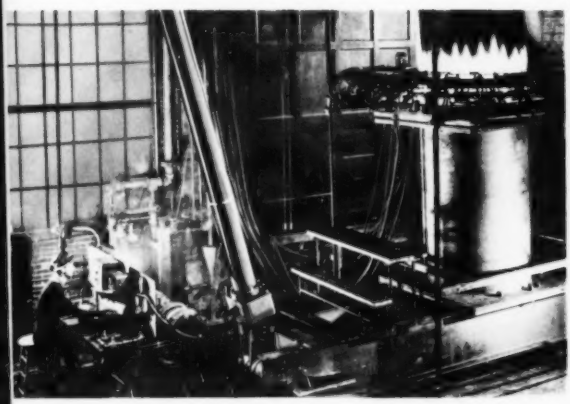
KELLOGG
1901 1951
50th Anniversary

*we built in 1901 . . . the first crude vessels for oil refiners in the 'teens . . . our first combination unit . . . the forty-odd Fluid cat crackers built in these years. But, after all, The M. W. Kellogg Company is only a factor as it is able to serve industry today. For that reason, we are presenting this series of monthly camera studies which document our belief that a truly integrated organization can better serve industry to achieve greater earning power. This is No. 9 in the series.*

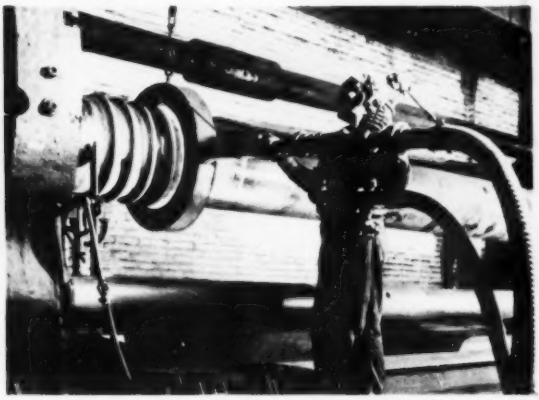
**2.** *STRESS RELIEVING FURNACES* are a basic element of the Shops' facilities. However, from this more or less routine shop operation, Kellogg metallurgical groups have evolved special stress relieving "specs" and techniques that have proved invaluable in the field—both in fabrication of vessels and in the installation of piping systems for power and process applications.



**3.** *PROCESS PIPING OF ALL TYPES* represents a major part of the Shops' volume—with high temperature, high pressure piping systems for utility power stations also being an important phase of Contract Engineering volume. Some recent Kellogg firsts in this latter highly specialized field are the first installation to operate at 1050 F and 1730 p.s.i.g. and the first stainless steel alloy installation.



**6.** *THIS KELLOGG INVENTION* can bend process pipe up to 96 inches in diameter — with continuous, even contour. Operated through electrical controls, the machine produces giant pipe bends that have promoted processing efficiency by minimizing erosion and stress corrosion and markedly reducing turbulence.

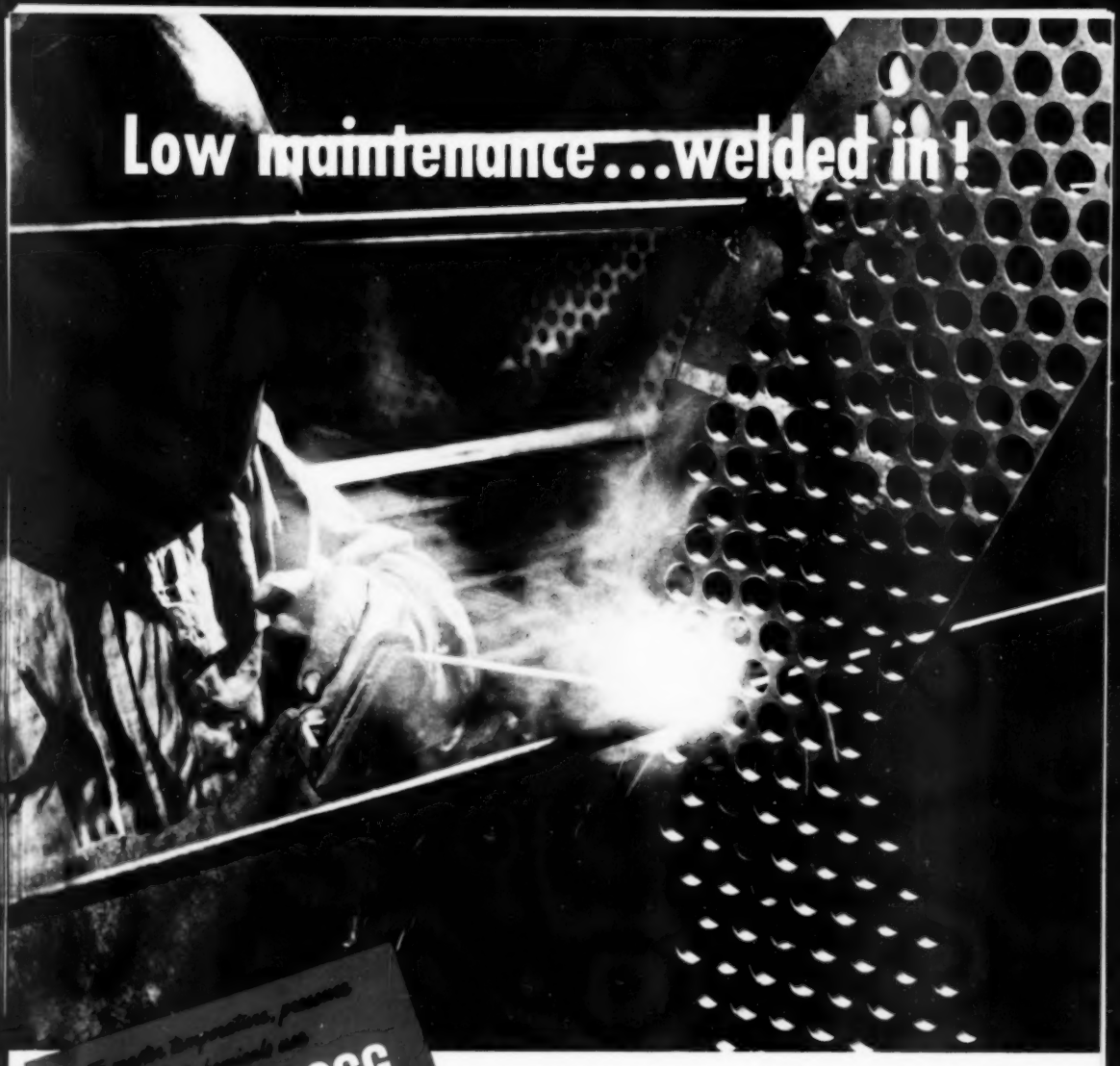


**7.** *ON THIS MACHINE, KELLOGG* fabricated the first 30 inch O.D. diameter alloy corrugated piping through use of much the same technique as employed on the Giant Bender: controlled incremental heating and subsequent controlled application of pressure.

## NEXT MONTH

*. . . in the tenth of this series of camera studies of M. W. Kellogg today . . . the camera completes the Shop story and moves out on the construction lot to review some of the methods Kellogg employs to win "construction's battle with time."*

# Low maintenance...welded in!



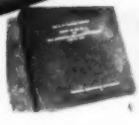
To make hydrocarbons, processes and chemicals safe

**M. W. KELLOGG**

process hydrocarbons

*Such details as the positioning of this simple weld on an exchanger baffle plate can radically vary maintenance costs of an operating exchanger. Low maintenance costs have been a design fetish of Kellogg engineers for many years. They design with low maintenance as a principal "spec"...then see that the "spec" is reproduced in every piece of Kellogg-fabricated equipment.*

Pressure Vessels
Vacuum Vessels
Fractionating Columns
Drums and Shells
Heat Exchangers
Process Piping
Hi pressure - Hi temp
Power Piping
Bends and Headers
Giant One Piece Bends
Forged and
Welded Fittings
Radial Brick Chimneys



**Continuing Basic Study** of heat exchange by Kellogg development groups over 20 years has produced unduplicated design data.

**Shop Layout Craftsmen** have had experience on all types of heat exchangers from marine condensers to jet engine combustion chambers.

**Rigid Quality Control** is maintained by inspectors reporting directly to Shop Management rather than to Production executives.

**Extensive Shop Facilities**, from plate forming to stud threading, permit complete fabrication of any type heat exchanger.

**Special Shop Techniques**—the component parts of each exchanger are fabricated as a production unit, building in the advantages of "tailor made" fit.

NEWS FOR OPERATORS IN WESTERN CANADA:

The Canadian Kellogg Company Ltd. has established complete shop facilities for the fabrication of all types of piping at **EDMONTON**, Alberta. Inquire directly or through any Kellogg or Canadian Kellogg office.

**The M. W. Kellogg Company** *(A Subsidiary of Pullman Incorporated)* **New York, Jersey City, Los Angeles, Tulsa, Houston, Toronto, London, Paris**

# This Assembly is Ready to Go

Here's an assembly that's ready to go to work in a wide variety of high-temperature, high-pressure bolting applications. It consists of the Bethlehem Alloy Steel Continuous-Thread Stud, and two Bethlehem Quenched Nuts.

The Bethlehem Alloy Steel Continuous-Thread Stud is ideal for economical high-temperature, high-pressure bolting because it minimizes stress concentrations. There being no point of thread runout, stress concentrations can't concentrate at any one point, but instead are effectively distributed over its entire working length.

And the Bethlehem Quenched Nut, supplied with the Bethlehem Alloy Stud, has plenty of staying power because of its built-in strength. The quenched nut is unlike ordinary nuts because it is made by forging and extruding hot metal into a forming die, after which it is quenched and tempered. This procedure provides sufficient strength for the nut to break virtually any stud or bolt on which it may be used.

Bethlehem Alloy Continuous-Thread Studs and Quenched Nuts are made in a complete range of sizes. They form an effective, long-lasting combination for high-temperature bolting—one that's well worth looking into.

BETHLEHEM STEEL COMPANY
BETHLEHEM, PA.

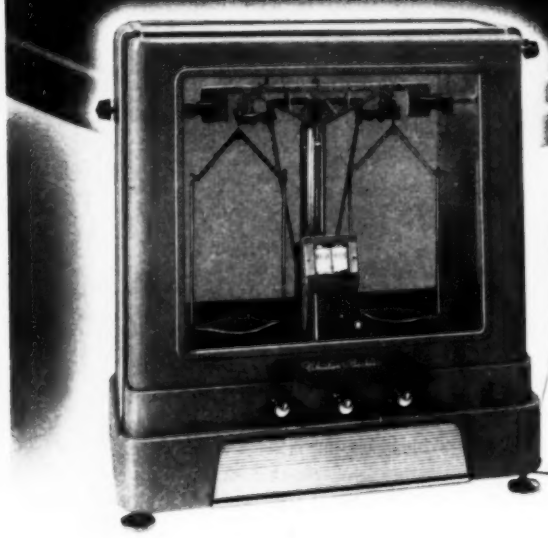
*On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. Export Distributor: Bethlehem Steel Export Corporation*

BETHLEHEM STEEL

## Bethlehem supplies every type of Fastener

## Speedy, Accurate Weighings • Improved Operation • Prolonged Sensitivity

*with the new*



# CHRISTIAN BECKER Projectomatic Analytical Balance

The newly designed Projectomatic balance makes possible automatic weighings from 1/10 mg to 100 mg, the results of which may be read on the magnified image of the scale which is projected onto a conveniently located screen.

In addition to the unique projection device, this balance features a new "floating" neoprene-cushioned black glass base plate to which no mechanism is mounted. With this arrangement breakage hazards are minimized, and a sturdy more rigid construction is achieved.

The model AB-1 is a double pan balance. Accordingly on a balance of this type it is possible to tare containers. Since it is recognized that in many weighing operations taring is an absolute necessity, a balance of the AB-1 type is desirable for most installations. In addition, this type of balance, although adapted for repetitive weighing, is ideal for routine laboratory work.

**H-1843**—Christian Becker Projectomatic Analytical Balance . . . . . Each **$795.00**

## Specifications

**Capacity**—200 grams.

**Beam**—18.1 cm, of a special alloyed aluminum of great strength and uniform density. The beam is graduated left to right, 0 to 1 gram in 0.1 gram graduations (no weights below 1 gram required).

**Projection System**—the new Projectomatic makes possible automatic weighings from 1/10 mg to 100 mg. A vernier is provided for direct and positive reading to 0.1 mg. The zero of the screen is readily adjustable from outside the case.

**Knife Edges**—Agate. All knife edges are rigidly set in the beam.

**Bearings**—Agate Planes.

**Releasing Mechanism**—Beam Arrest. The special construction of the beam arrest insures the positive alignment of the agate edges with their respective bearings.

**Damper**—Magnetic damping arrests the oscillation of the beam almost immediately.

**Rider Carrier**—The enclosed vertical lift insures accurate alignment, in all positions, of lifting hook with the beam.

**Pans**—Stainless Steel, $2\frac{7}{16}$ in. diameter.

**Bows**—Brass, coated with a hard chemically resistant lacquer. Straight sides to accommodate large drying tubes, etc., $4\frac{1}{8}$ in. x $8\frac{1}{2}$ in. high.

**Pan Arrest**—The new independent pan arrest for pans with a positive stop.

**Vibration Dampers**—Special built-in dampers at each balance support dampen objectionable outside vibrations.

**Sash Balance**—The newly developed stainless sash balance for raising the front door eliminates the troublesome sash weights. The door opens wider, and more smoothly.

**Case**—$18\frac{1}{4}$ in. x 9 in. x 20 in. high. Aluminum with glass top and front panel and a removable back panel. The newly designed sliding front door, which actually comprises a portion of the side of the case, eliminates the objectionable conventional front corner posts. The case exterior is finished in an attractive chemically resistant finish. The interior is white to brighten working area. Case provided with a drawer.

**HARSHAW SCIENTIFIC**
DIVISION OF THE HARSHAW CHEMICAL CO.
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**BS&B**'s records make up quite a library of **SAFETY HEAD** applications and users. Through the years, their accuracy and completeness save time, eliminate confusion and error.

It's another example of **BS&B** thoroughness in the exclusive manufacture of these versatile pressure relief devices. No other relief device acts so quickly. The **SAFETY HEAD** absorbs the shock of overpressure... provides a fully open, pipe-size opening after disc rupture. Eliminates injuries, equipment loss. Avoids costly shut-downs. Tamper-proof, fool-proof **SAFETY HEADS** *are a must if you have equipment under pressure!*

An analysis of your pressure problem is yours without cost. Write today for details... ask for latest catalog.

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**Kansas City 3, Missouri**

**SAFETY HEADS**
**for**
**Positive Pressure Protection**

# Does F.O.B. mean "Frank's On Board"?

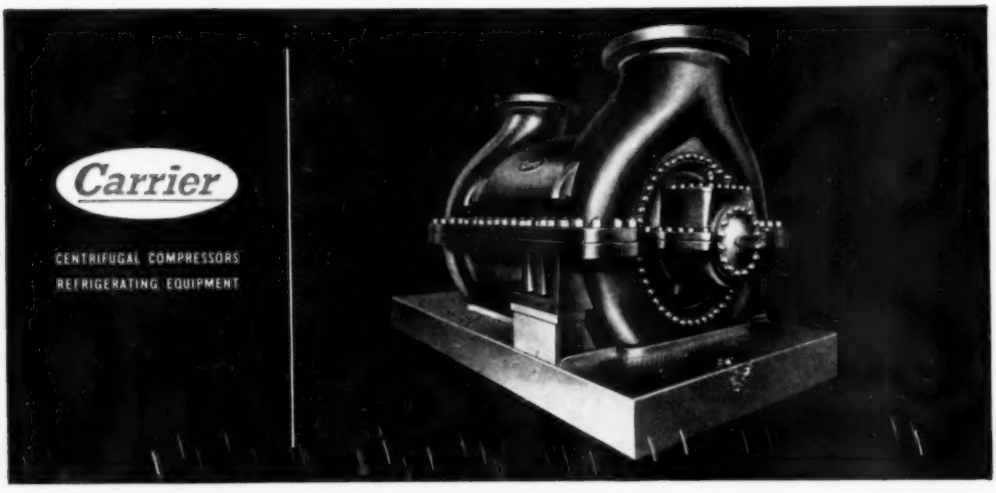
It could. Because when Carrier ships a Centrifugal Gas Compressor, one of our supervisors *is* on board.

**He's one of our many specially trained experts. He *knows* heavy equipment. And he knows it from *experience*. He goes along with each Carrier compressor and lives with it till it's installed exactly right and running exactly right.**

Not that installation is so tough. Because our Centrifugal can go outside without protection or any heavy, complicated foundation. And while the casing is strong enough to stand pressures up to 500 pounds per square inch, still it's designed without any extra weight or size.

**Nor is its operation complicated. Because our Centrifugal has only one major moving part, designed for maximum life.**

So "Frank" goes along just to be sure the Centrifugal gets off to a good start. Because we've found *from experience* that when they do, they keep going for years and years. Our original Centrifugal installations of more than 25 years are still giving top performance. Write us and we'll tell you more. Carrier Corporation, Syracuse 1, New York.




***The Carrier Centrifugal Gas Compressor,*** available with intake volumes of from 1000 to 40,000 cfm at discharge pressures ranging from 100 to 500 psig. Temperatures as low as —150° F. possible.

WELDOLETS
WELDING FITTINGS FOR ANY PIPING SERVICE

# WHEN POWELL VALVES GO IN, MAINTENANCE GOES OUT!

**With today's urgent need for maximum production, why take a chance on any valves that require constant attention?**

**By installing Powell Valves—built for perfect performance with minimum maintenance—you can stop worrying about your flow control equipment.**

Fig. 375. Small 200-pound Bronze Gate Valve with renewable, wear-resisting "Powellium" nickel-bronze disc.

Gate, Check, Globe and Y Valves, in Bronze, Iron, Steel and Corrosion-Resisting Metals and Alloys

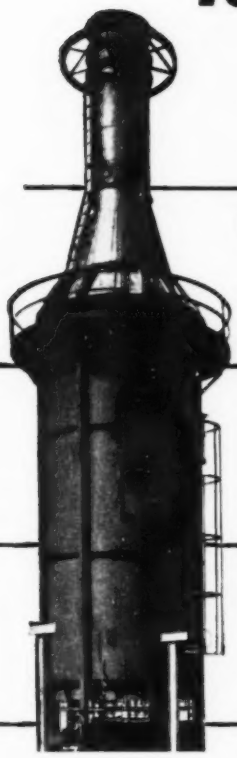
★ *Quality fine throughout "The Line"* ★

# POWELL

**The WM. POWELL CO., 2525 Spring Grove Ave., P. O. Box 106, Station B, Cincinnati 22, Ohio**

# *There's a* PETRO-CHEM ISO-FLOW *furnace* .....

***for** every fluid heating service, capacity or duty, irrespective of temperature pressure range.*

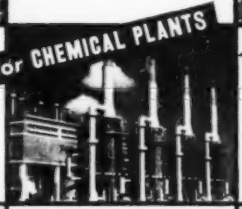


**for REFINERIES**

crude distillation, vacuum distillation, thermal cracking, catalytic cracking, thermal reforming, catalytic desulphurization, catalytic reforming, solvent refining, isomerization

**for RECYCLING PLANTS**

**for CHEMICAL PLANTS**



catalysis heaters with catalyst in tubes, steam superheating to 1500° F. gas cracking, reactant distillation, direct fired reboiling

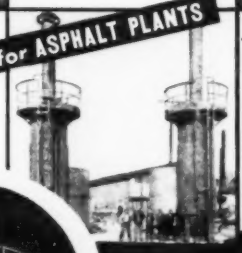
rich oil distillation, secondary fractionation, depropanizing, debutinizing, reboiling heat medium

**for GAS PLANTS**

at individual leases and for main line dehydration for catalyst regeneration—up to 500,000,000 cubic feet per day, unlimited pressure

**for PIPELINES**

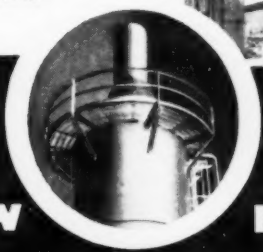
**for ASPHALT PLANTS**



gas dehydration, gas and air superheating for turbine drives, reduction of viscosity of oil in long transmission lines

including tank heating, loading heaters, manufacture of linoleum, roofing and tile—circulating heaters for saturates

***Throughout the world, in the petroleum, chemical and allied industries, there are more than 800 Petro-Chem Iso-Flow Furnaces performing to the complete satisfaction of their operators and generally well in excess of their rated capacities.***



# PETRO-CHEM ISO-FLOW FURNACES

UNLIMITED IN SIZE . . . CAPACITY . . . DUTY

PETRO-CHEM DEVELOPMENT CO., INC., 120 EAST 41ST STREET, NEW YORK 17, N.Y.

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# 5 Quality Products for the Petroleum Industry

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## SODA ASH

## CAUSTIC SODA

## CAUSTIC POTASH

(Liquid, Solid and Flake)

## CALCIUM CHLORIDE

## SODIUM NITRITE

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SOLVAY
Alkalies Chemicals
70 YEARS OF SERVICE
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**SOLVAY SALES DIVISION**
Allied Chemical & Dye Corporation
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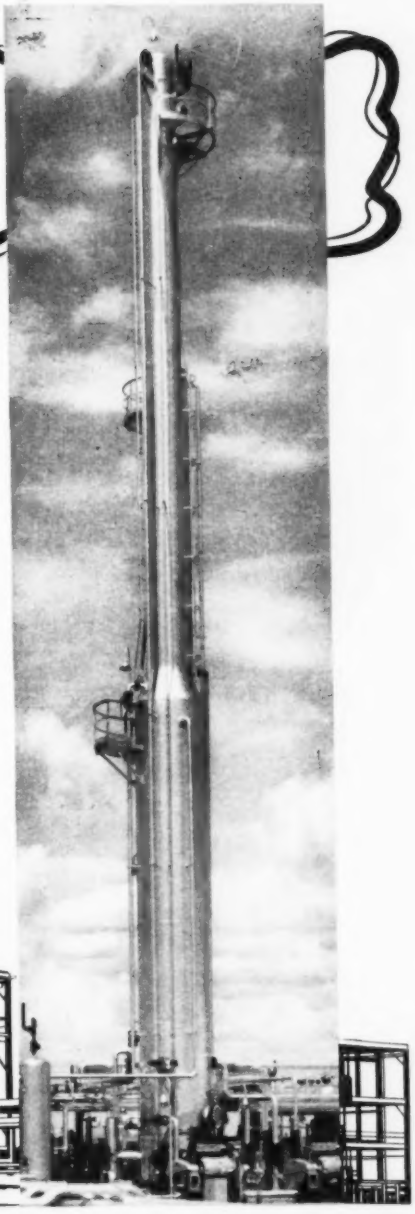
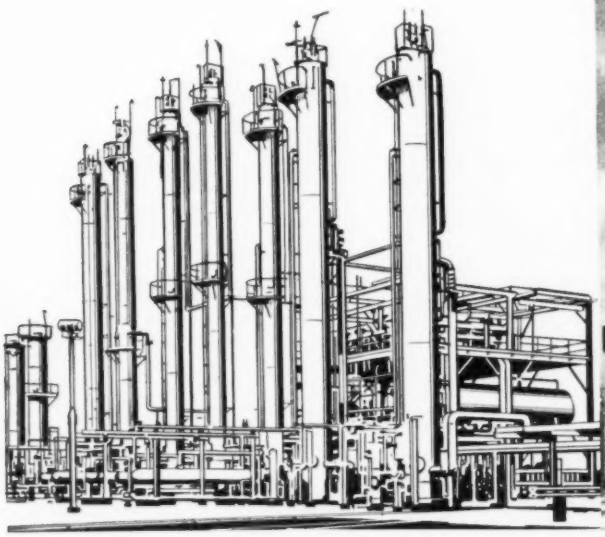
# Horton Tower with a *Double Purpose*



THIS 94-ft. Horton tower is a rich oil contactor- reabsorber recently installed at a large Oklahoma refinery. In effect, it is two process columns in one. The contactor portion is the lower 6-ft. diam. section; and the reabsorber is the upper 3-ft. diam. section. The net effect of this tower's operation is to remove ethane and lighter hydrocarbons from the rich oil stream and, at the same time, to scrub rejected gas from the distillation end of the plant in order to recover any propane which may have been lost.

This Horton tower is another outstanding example of special plate structures we build to meet a wide variety of pressure, temperature and vacuum conditions at petroleum plants. Write our nearest office for full details.



## CHICAGO BRIDGE & IRON COMPANY

*Plants in BIRMINGHAM, CHICAGO, SALT LAKE CITY and GREENVILLE, PENNSYLVANIA*

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| Boston 10 | 1029-201 Devonshire Street | Los Angeles 17 | 1526 General Petroleum Building | Seattle 1 | 1330 Henry Building |
| Chicago 4 | 2114 McCormick Building | New York 6 | 3310-165 Broadway Building | Tulsa 3 | 1620 Hunt Building |
| Cleveland 15 | 2215 Guildhall Building | Philadelphia 3 | 1630-1700 Walnut St. Building | Washington 6, D. C. | 1135 Cafritz Building |

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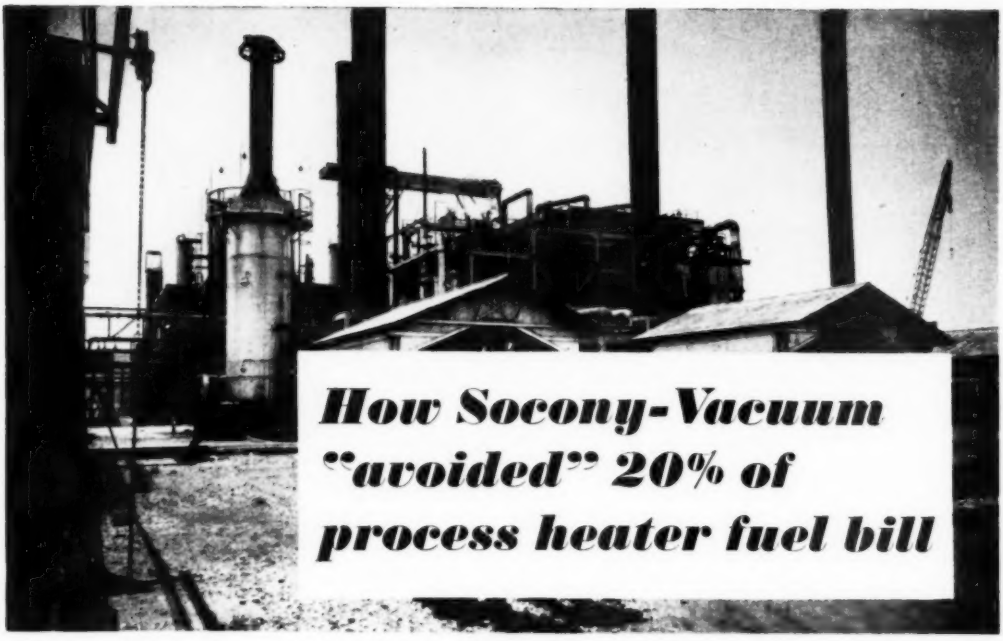


# How Socony-Vacuum "avoided" 20% of process heater fuel bill

**program**

When engineers at Socony-Vacuum, Trenton, Michigan refinery developed a complete fuel conservation program, process heaters came under close scrutiny. Socony-Vacuum engineers felt they could reduce the total cost of fuel used in raising the temperature of petroleum stock if they could keep the amount of excess air in the flue gases at a minimum.

**need**

Socony's instrument engineers wanted an instrument which would indicate excess air, so that they could make adjustments to keep the air at a minimum and thus save fuel.

**specifications for instrument**

must provide a **continuous indication** so that changes could be spotted immediately.

must **not be affected by changes in fuel composition** since different fuels are used in the heater furnaces.

must not **be affected by the presence of Hydrogen** in the gas sample.

preferably, measurement should have **direct relationship to excess air.**

**selected**

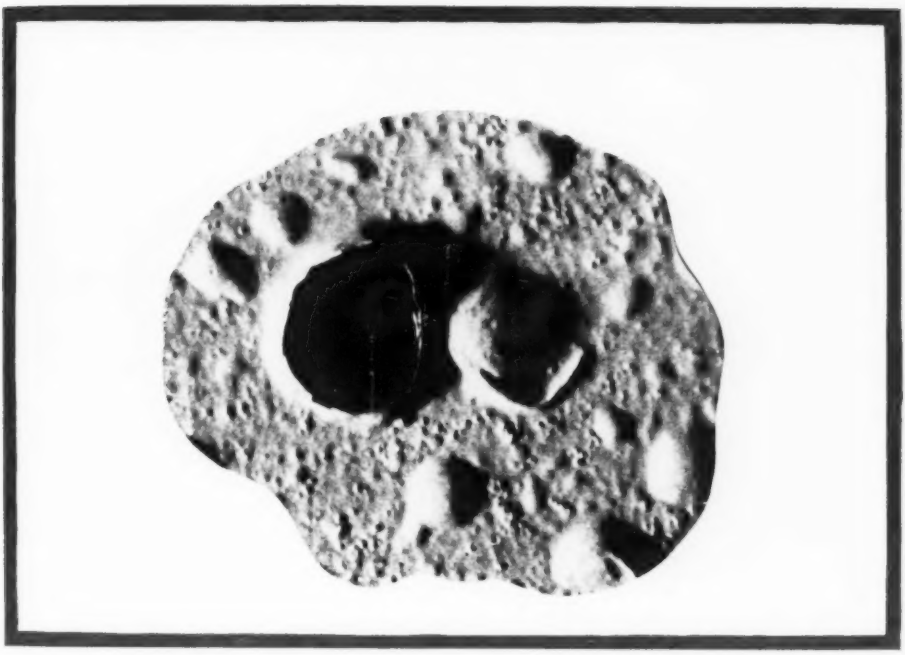
**four HAYS MAGNO-THERM OXYGEN ANALYZERS and two HAYS 2-PEN ELECTRONIC RECORDERS**

***results***

The entire fuel conservation program brought a 20% reduction in Socony's annual fuel bill. The Hays Oxygen Recorders have proved an effective combustion guide on the process heaters.

***Improvement in the efficiency of your process heaters can mean large fuel savings. Write for Bulletin 50-829, 16 pages of information on how the $O_2$ meter works, where it's used, etc. No obligation.***

THE **HAYS** CORPORATION ***MICHIGAN CITY 23 INDIANA*** • Automatic Combustion Control • Boiler Panels • Hays-Penn Flowmeters • Veriflow Meters and Veritrol • Gas Analyzers • Draft Gages • Combustion Test Sets • $CO_2$ Recorders • Electronic Oxygen Recorders



# A Penny Saved is a Penny Earned?

Not always! Here's a quick picture of the "saving" of a few pennies on a protective coating! Here's a close-up of the costly corrosion that results!

When it comes to protecting your equipment against chemical attack — don't be "penny wise and pound foolish". Use a truly chemical-resistant coating. Use TYGON "Series TP" PAINT.

In refineries, TYGON PAINT does an excellent job of protecting such equipment as sour crude tanks, acid sludge tanks, run-down tanks, refrigeration units, alkali tanks, pumps, piping, fume ducts and hoods, and fire-fighting equipment against corrosive fumes and spillage. Structural steel, walls, and ceilings also benefit from TYGON protection.

Sulfuric acid, hydrochloric acid, phosphoric acid, caustic soda, ammonia, magnesium chloride, salt, hydrogen sulfide, sulful dioxide are just a few of the refinery chemicals resisted by TYGON.

Available in a wide range of colors, TYGON PAINT is easily applied and quick drying — requires no more than normally good surface preparation. Once dry, its film is tough, smooth, flexible and non-flammable. It's easy to clean and seemingly ageless, too.

Properly applied, TYGON PAINT is low cost insurance against costly corrosion.

Write, today, for full details and technical data. Ask for Bulletin 720.

Address: U. S. Stoneware Co., Akron 9, Ohio,
Plastics and
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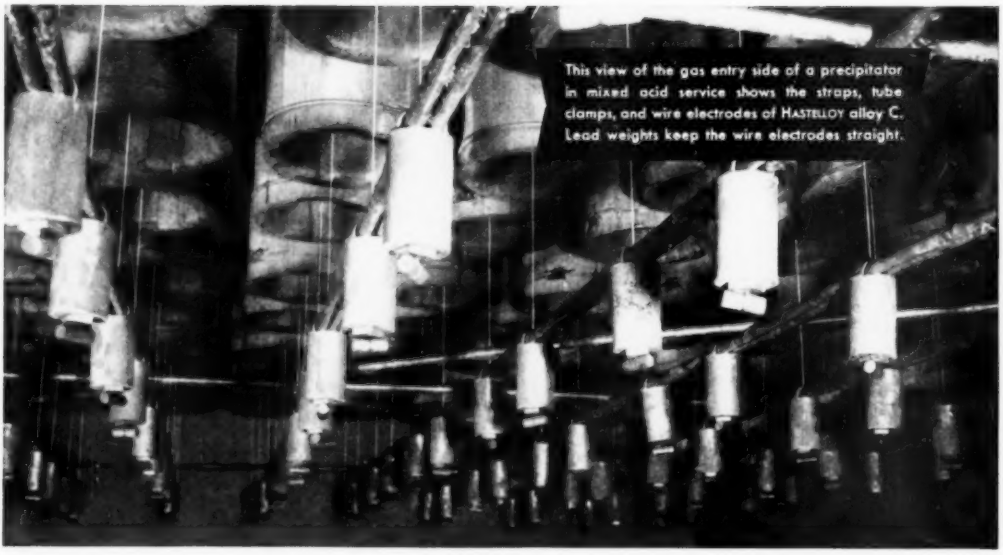
195C



This view of the gas entry side of a precipitator in mixed acid service shows the straps, tube clamps, and wire electrodes of HASTELLOY alloy C. Lead weights keep the wire electrodes straight.

# Precipitators Improved...

## WITH NICKEL-ALLOY ELECTRODES

Electrostatic precipitators for removing corrosive liquids and solid particles from industrial process gases give better and longer service, without maintenance, when HASTELLOY alloy wire is used for electrodes. The alloy has excellent mechanical strength (130,000 psi) and is not attacked by the corrosive agents. This combination of properties makes it possible to use electrodes that are only 0.073 in. in diameter. The effective diameter of the lead-covered wire formerly used in most units was more than 0.500 inch. The smaller cross-section of the HASTELLOY alloy wire permits the use of higher voltages with a more uniform corona pattern.

HASTELLOY alloy C electrodes have been installed in mist precipitators where hydrochloric, sulphuric, sulphurous, and mixed acids were present. A recent check on an installation in an acid plant showed that the alloy C wires experienced no weight loss after a year's operation. Lead-covered steel wires, on the other hand, lasted an average of 11 months with electrode failure at least once a week.

For information on wrought forms of HASTELLOY alloy, write for the booklet, "HAYNES Wrought Alloys Price List."

**HAYNES** TRADE-MARK *alloys*

"Haynes" and "Hastelloy" are trade-marks of Union Carbide and Carbon Corporation.

**Haynes Stellite Company**
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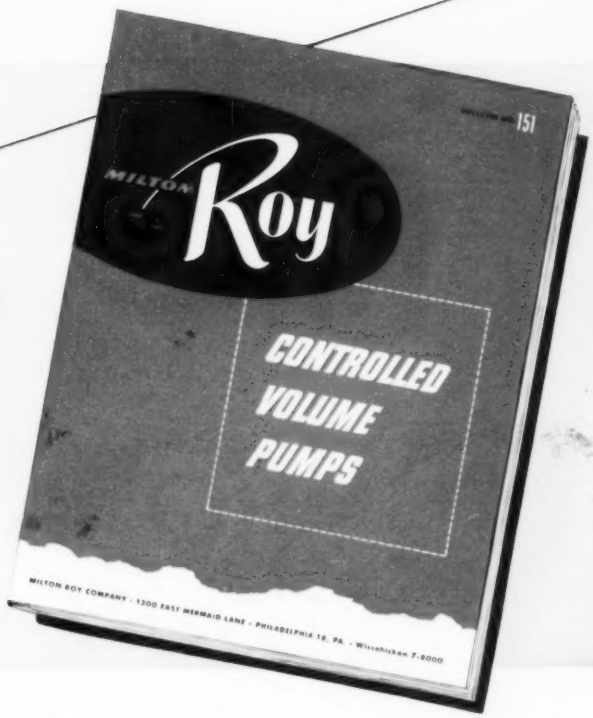
**Los Angeles — New York — San Francisco — Tulsa**

# CONTROLLED VOLUME PUMPING


BULLETIN NO. 151
MILTON Roy
CONTROLLED VOLUME PUMPS
MILTON ROY COMPANY · 1300 EAST MERMAID LANE · PHILADELPHIA 18, PA. · Wissahickon 7-8000

## This Milton Roy Bulletin No. 151 Gives You **COMPLETE DETAILS**

Bulletin No. 151 is filled with information on controlled volume pumping. Here are a few of the many important details you'll find in the book:

- an explanation of controlled volume pumping.
- a description of what controlled volume pumping can do for you—what it does for others in the chemical, textile, petroleum, pulp and paper, paint, food and beverage, water treatment, pharmaceutical, and brewing industries and in instrumentation, pilot plants and laboratories.
- a description of how Milton Roy Controlled Volume Pumps give users maximum benefits: how any desired rate of delivery, from zero to full capacity, can be maintained with accuracy; how deliveries as low as 3 milliliters per hour can be held with precision; how difficult-to-pump materials, such as slurries, viscous liquids, solids in suspension, etc., are readily handled.
- 4 pages of color charts which show in dramatic "traffic-light" style the relative corrosion resistance of materials of construction to over 170 chemicals. These valuable reference charts summarize industry-wide data.
- a description of the features that make Milton Roy Controlled Volume Pumps perform flawlessly on services where no other pump has filled the need.

If your operations call for pumping a controlled volume of liquid in amounts as much as 50 gallons per *minute* or as little as 3 milliliters per *hour*, you'll find this book extremely valuable.

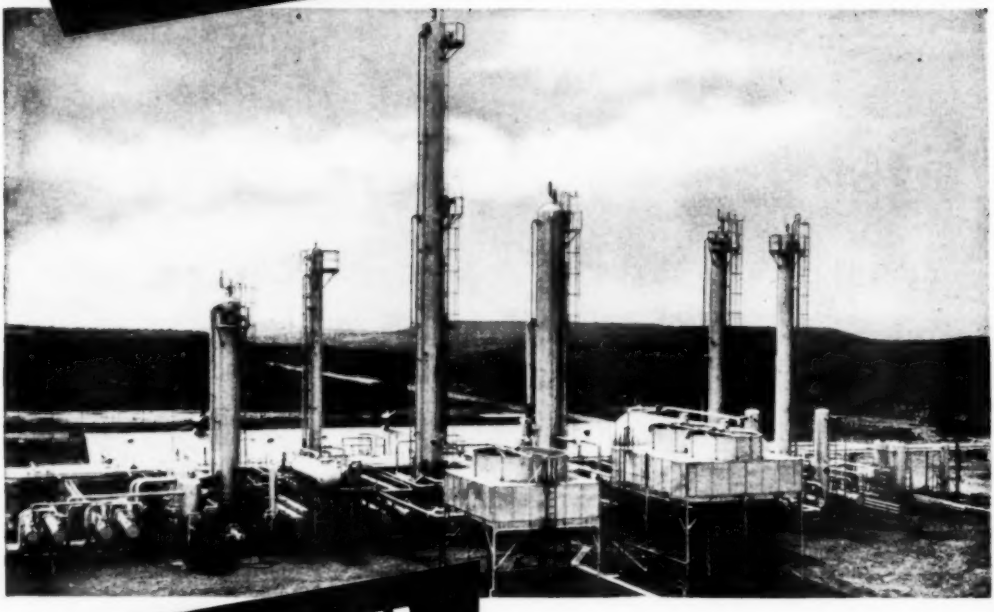
For your free copy of the 24-page, 2-color Milton Roy Bulletin No. 151, write or call the Milton Roy representative listed in your telephone directory. Or, if you prefer, write direct to us.

MILTON Roy COMPANY

1408 EAST MERMAID LANE, PHILADELPHIA 18, PA.

MANUFACTURERS OF CONTROLLED VOLUME PUMPS AND AUTOMATIC CHEMICAL FEED SYSTEMS

# Reduce Fouling in your plant



with **BROWN FINTUBE** *sectional hairpin heat exchangers*

● Brown Sectional Heat Exchangers, with their integral one-piece extended surface fintubes, reduce fouling, just a few hundredths of an inch of which on a tube causes a major loss in heat transfer efficiency.

These exchangers assure efficient operation at low "skin" temperatures, minimizing coking and building up on the fintubes. And the controlled flow through the longitudinal passages keeps all the material in continuous motion. There are no baffles, back-eddies or stagnant areas to encourage fouling.

For top operating efficiency and reduced fouling use Brown Sectional Heat Exchangers throughout your plant. ***Write for Bulletin No. 481.***

**THE BROWN FINTUBE CO.**
*Elyria, Ohio*

Sectional Hairpin Heat Exchangers
Tank Suction and Line Heaters
Fintube Heaters for Bulk Storage Tanks
Indirect Process Air Heaters
Fintube Heaters for Processing Tanks
Integrally Welded Fintubes for Any Heating, Cooling or Heat Transfer Service

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*Trade-Mark

for an extensive line of oxygenated solvents and chemicals

The famous ENJAY* Oval Trade-mark stands for a diverse line of high-quality chemicals and solvents. An increasing number of industries are using dependable Enjay chemicals to increase product quality.

EXPERIENCED

RELIABLE

DIVERSIFIED

ENJAY markets this wide range of industrial chemicals:

Petrohol 91 (Isopropyl Alcohol)
Petrohol 95 (Isopropyl Alcohol)
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Methyl Ethyl Ketone
Ethyl Ether
Isopropyl Ether
Diisobutylene
Polypropylenes
Butadiene
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Dicyclopentadiene
Aromatic Tars
Paratone
Parapoid
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Paranox
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Enjay products are marketed in drum and tank car quantities

ENJAY COMPANY, INC.
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# *DRUMS*...for Dutch Harbor or Donghoi!

Whether for mobilization, civilian demand or world economic aid, the petroleum industry must be prepared for any eventuality . . . wherever it occurs.

Petroleum can do its job . . . and do it well . . . just as in World War II when more than 60 per cent of the dead-weight tonnage shipped overseas was petroleum. Today, providing petroleum products for every need is a bigger job. Civilian demand has jumped more than 50 per cent since V-J day. Modern military machines call for greater quantities of extra-special fuel. To meet these situations, requires careful, co-ordinated planning and accurate analyses of trends. To assist in their planning, refinerymen have learned to depend upon *Petroleum Processing*.

In peace or war, petroleum products are top-priority items. If the equipment, services or materials you have to sell are used in refineries, you can be assured of a consistent market . . . a market that stands high on every priority list. And if your advertising seeks to reach the key buying factors in this market, certainly the medium through which to do it is the publication that rates *top priority* with refinerymen. That publication is *Petroleum Processing*.

THE BEST-READ REFINERY PUBLICATION
REACHING THE MOST REFINERY READERS

*A Platt Petroleum Publication*

**Headquarters, 1213 W. Third St., Cleveland 13, Ohio . . . Offices in New York, Chicago, Philadelphia, Houston and Los Angeles**

# *A simple process for the conversion of waste hydrogen sulfide to pure elemental sulfur*

The availability of sulfur is rapidly becoming critical to the refining industry. First pinch was evident when sulfur and sulfuric acid were placed under allocation control by National Production Authority.

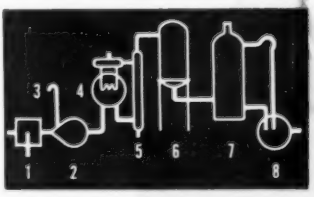
Primary cause of sulfur allocation is a gradual depletion of known deposits. Secondary cause is the great demand for sulfur in the manufacture of vital defense program materials. Mined sulfur is the normal source for such materials. The refiner, however, has in most cases his *own* potential source of sulfur.

## *Recovery from waste*

The refiner's answer is the Mathieson Process for converting into sulfur the waste hydrogen sulfide recovered from sour petroleum gases. This simple process – available through The Fluor Corporation, Ltd. – accomplishes *two* important purposes:

1. *Guarantees independent supply* by affording each refiner an independent sulfur supply to meet his particular requirements – protection for the present, additional income for the future.

2. *Conserves for national defense* by contributing to the over-all National Defense Program in helping to conserve a critical commodity.




**THE MATHIESON SULFUR RECOVERY PROCESS**
**Hydrogen sulfide, recovered from a sour gas stream, is partially burned with air—cooling follows with steam generated being utilized for power. Combustion gases are then passed through a catalyst tower to form sulfur and water vapor. Elemental sulfur product is condensed in a wash tower by direct contact with cooled liquid sulfur. The result is pure commercial sulfur—ready for sale or for conversion into sulfuric acid.**

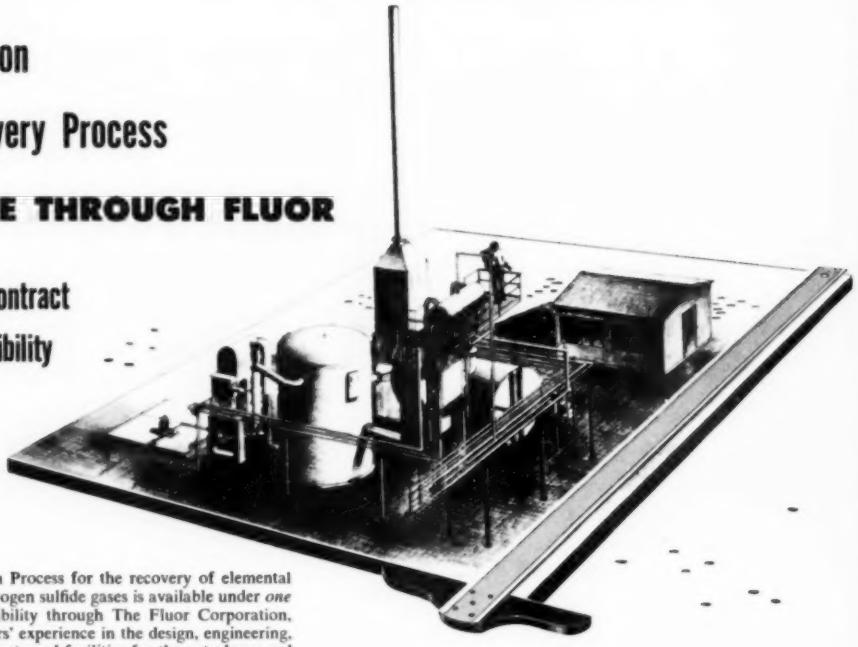
**1—TREATING PLANT, 2—REACTOR FURNACE, 3—AIR INTAKE, 4—WASTE HEAT BOILER, 5—ECONOMIZER, 6—CATALYTIC CONVERTER, 7—SULFUR WASH TOWER, 8—RECIRCULATING SUMP**

See Reverse Side

# The Mathieson Sulfur Recovery Process

## AVAILABLE THROUGH FLUOR

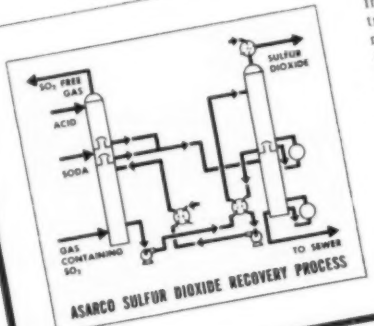
- Under ONE Contract
- ONE Responsibility



The proven Mathieson Process for the recovery of elemental sulfur from waste hydrogen sulfide gases is available under *one* contract, *one* responsibility through The Fluor Corporation, Ltd. With over 30 years' experience in the design, engineering, and construction of plants and facilities for the petroleum and chemical industries, Fluor possesses the background, the skilled personnel, and the know-how essential for the practical interpretation of the Mathieson Process into *your particular* sulfur recovery program.

**Fluor is in a position to make economic studies covering every phase of proposed sulfur recovery installations—initial investment, operating costs, and returns to the investor.**

***A process for the recovery of Sulfur Dioxide is also available through FLUOR***



ASARCO SULFUR DIOXIDE RECOVERY PROCESS

In line with Fluor's expanding activity in the fields of gas treating and sulfur recovery, arrangements have been made with the American Smelting and Refining Company (ASARCO) for Fluor to design, engineer and construct sulfur dioxide recovery plants using the ASARCO Process. Fluor's investigations have shown this process to be the most suitable of any available for the removal and recovery of pure sulfur dioxide from stack gases. In the application of the process, the gas is scrubbed with dimethylaniline which is then fed to a stripping column for sulfur dioxide recovery in a cyclic process. The resulting sulfur dioxide product may be dehydrated and liquefied for sale as liquid $SO_2$ or fed directly to an acid or sulfur plant.

**All details including first studies are available through The Fluor Corporation, Ltd., and the American Smelting and Refining Company.**

BE SURE WITH

**FLUOR**

THE FLUOR CORPORATION, LTD., 2500 S. Atlantic Blvd., Los Angeles 22, Calif.

New York, Chicago, Boston, Pittsburgh, Tulsa, Houston, San Francisco, Birmingham, Calgary.

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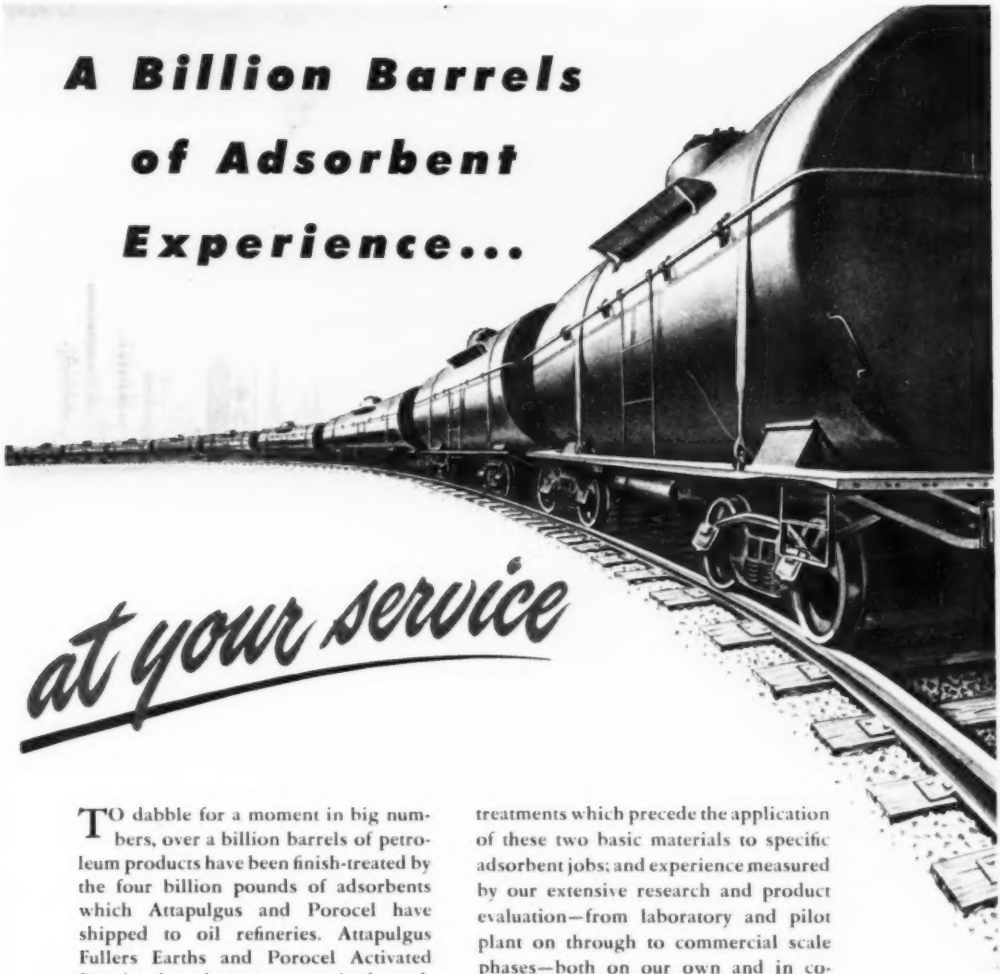
# A Billion Barrels of Adsorbent Experience...



*at your service*

TO dabble for a moment in big numbers, over a billion barrels of petroleum products have been finish-treated by the four billion pounds of adsorbents which Attapulgus and Porocel have shipped to oil refineries. Attapulgus Fullers Earths and Porocel Activated Bauxites have become recognized standards in the removal or reduction of odors, colors, tastes, moisture, acids, sulfur, fluorides and unsaturates, and for solid catalyst purposes. And in this wide range of services, remarkable finished value was gained in a long list of petroleum cuts—from the lightest distillates to the heaviest lubes and waxes.

This all adds up to a lot of adsorbent experience—experience with the many treatments which precede the application of these two basic materials to specific adsorbent jobs; and experience measured by our extensive research and product evaluation—from laboratory and pilot plant on through to commercial scale phases—both on our own and in cooperation with our customers.

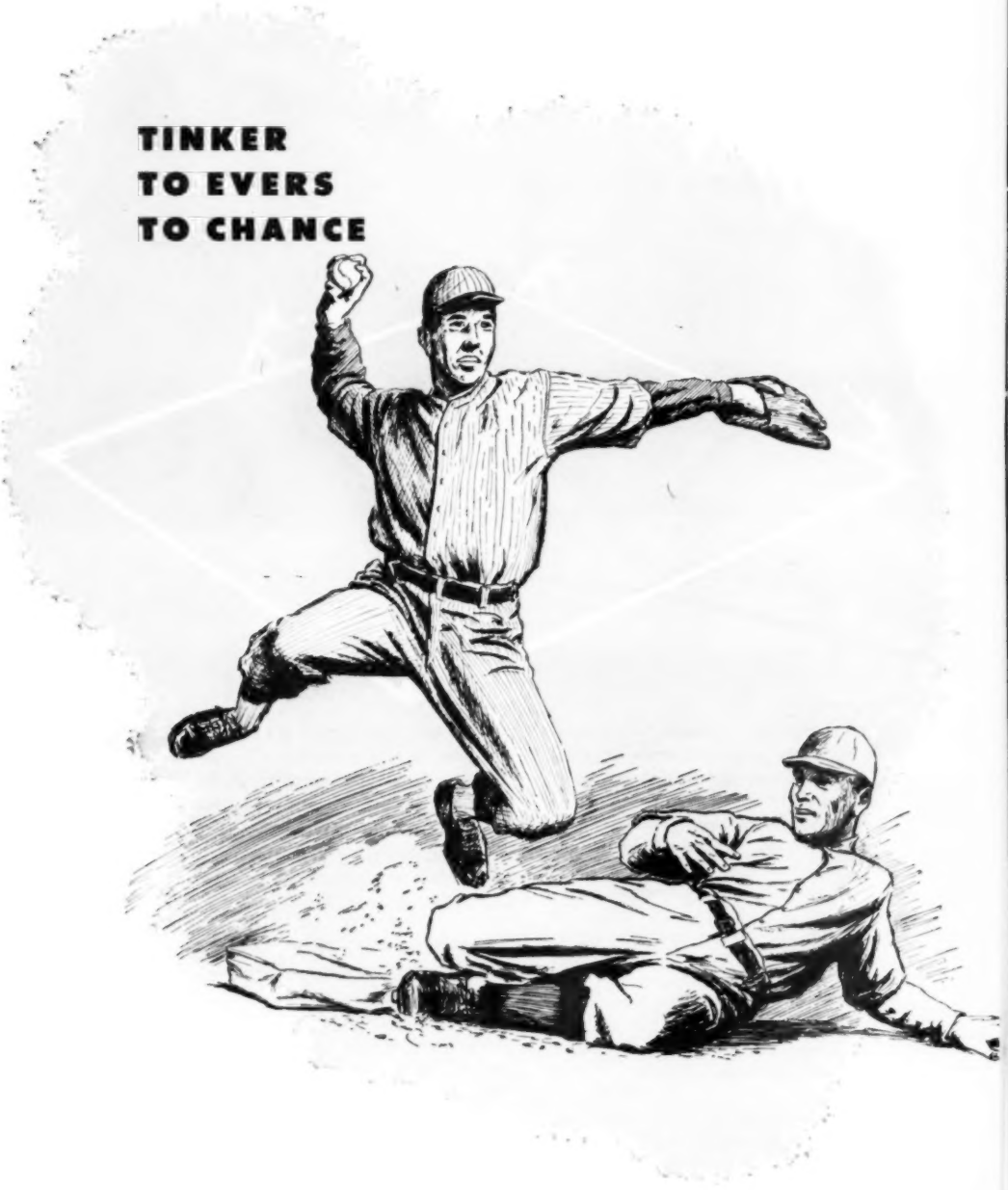
So there's great merit to the suggestion that it pays to consult Attapulgus and Porocel. In your own plans to improve products or expand output, perhaps our one billion barrels of adsorbent experience can be of real help to you in selecting the right adsorbent and the right conditions. Our laboratory and process staff are at your service, without obligation.

**ATTAPULGUS CLAY COMPANY** *Fullers Earth* • **POROCEL CORPORATION** *Activated Bauxites*

**Dept. D, 210 West Washington Square, Philadelphia 5, Pa.**




(*To obtain more data on advertised products see page* 1161)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## ANOTHER WAY OF SAYING UOP SERVICE IS COMPLETE

So swift . . . so sure was the immortal double play combination of the old Chicago Cubs that their names have become synonymous with *total teamwork.*

In the same way . . . UOP Service stays "on the ball" throughout every phase of process development and efficient refinery operation. Even in those "extra innings" — long after the plant is on stream — UOP field men are available, on request, to help maintain maximum operating efficiency.

This unique and comprehensive service . . . extended to refiners all over the world . . . has been a vital factor in the safe and efficient operation of refinery processing equipment and in the improvement of product quality.

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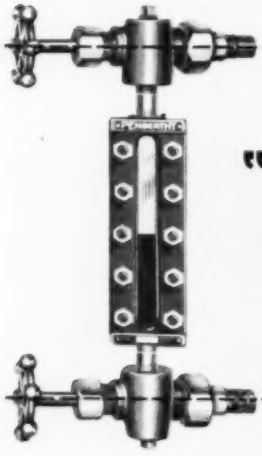
*Universal Service Protects Your Refinery*

Penberthy Reflex Gage



Penberthy Transparent Gage

# PENBERTHY "FLOATING SHANK"

## Permits 3/8" Variation in Center-to-Center of Vessel Tapping

Patent Applied for

**COMPENSATES FOR VESSEL TAPPING INACCURACIES**

•

**SAVES INSTALLATION TIME**

•

**REDUCES GAGE STRESSES**

*Another* **PENBERTHY** *First*

An important new feature now available on all Penberthy drop forged steel gage valves is the "floating shank" . . . an improvement that has money-saving advantages to many users of liquid level and water gages.

The "floating shank" compensates for inaccuracies in the center-to-center distance of the tapped holes in the vessel on which the gage is mounted. The variation can be as much as 3/8". It provides a mounting flexibility not elsewhere obtainable . . . it saves time during installation of the gage . . . it eliminates stresses that are often induced during mounting.

The Penberthy "Floating Shank" can be had at slight additional cost . . . specify it on your next order for Penberthy drop forged steel (or alloy) gage valves.

4449

**PENBERTHY INJECTOR COMPANY**

DIVISION OF THE BUFFALO-ECLIPSE CORPORATION

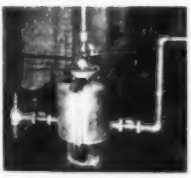
**Detroit 2, Michigan**

*Established 1886* *Canadian Plant, Windsor, Ontario*

### OTHER PENBERTHY PRODUCTS

**PENBERTHY CYCLING JET PUMPS**

Automatically operated by air, gas or steam pressure . . . Will pump without clogging any liquid that will flow through pipes. Ask for Bulletin 5030.



**PENBERTHY EXPLOSION-PROOF SUMP PUMPS**

Motor and switch totally enclosed. Underwriter approved for Class 1, Group D, and Class 2, Groups E, F and G hazardous location. Made of copper and bronze throughout. Ask for Bulletin 4929.

**PENBERTHY EJECTORS**

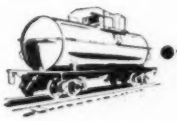
A simple jet pump operated by air, water or steam. Needs no lubrication . . . will not get out of order. Ask for Bulletin 5080.

# The + in Hooker Caustic Soda
## *is SERVICE*

When you buy a basic chemical like caustic soda, *service* is an important factor in determining your source of supply. As a basic producer, Hooker offers you these advantages:

1. Caustic soda of high purity, low in iron and sulfates . . .

*and*



2. Modern equipment for loading and shipping to maintain that purity from our plant to the user's plant . . .

+

**An experienced technical service staff to help you use and handle caustic soda.**

To you this means minimum processing costs through elimination of variations in quality from shipment to shipment. To make sure that Hooker Caustic reaches you as pure as it leaves us, we coat Hooker tank cars with a special protective lining. Each car is completely insulated and equipped with a heating device to make handling and unloading uniform the year around.

+ You can reduce processing costs further through the safe and efficient handling of caustic soda. This is where the specialized knowledge of our technical service staff can help you.

For analyses and specifications on Hooker Caustic Soda, write on your business letterhead for Technical Data Sheet No. 735.

Hooker Caustic Soda is sold in solid, flake or liquid form. Liquid is supplied in 50% and 73% concentration.

*From the Salt of the Earth*

**HOOKER ELECTROCHEMICAL COMPANY**

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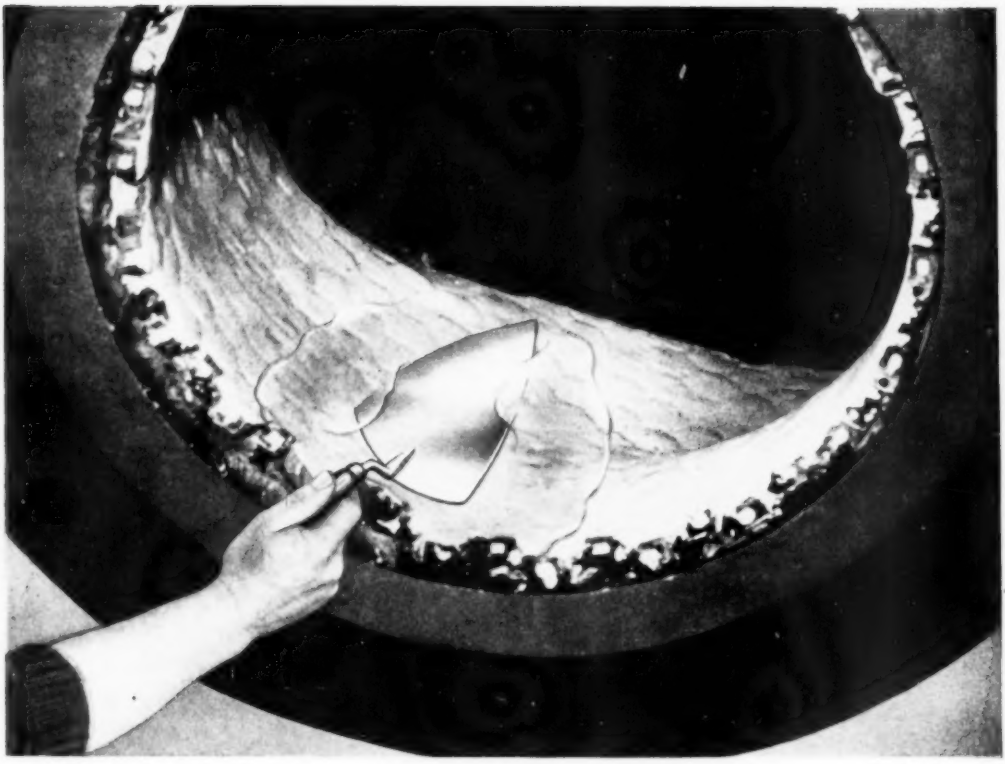
**HOOKER CHEMICALS** ®

1-1248

SODIUM SULFIDE • SODIUM SULFHYDRATE • SODIUM BENZOATE • CHLORINE • MURIATIC ACID • PARADICHLOROBENZENE • MONOCHLOROBENZENE



# NOW— install wear plates with a trowel

**...a new way to protect equipment from erosion and corrosion**

By combining Penchlor FCC Cement and a steel gridwork you can literally install "wear plates" with a trowel . . . thus solving the twin problem of erosion and corrosion.

The construction shown has met with outstanding success in lining fluid catalytic cracking equipment, such as cyclones, feed and return lines and large fittings. At points of severe wear the cement-steel combination withstands the abrasive action of high-velocity, fine catalyst particles and resists sulfation by petroleum gases at temperatures of 1250°F. and higher.

In addition, when you use Penchlor Grid Linings you can often design a less expensive wall section thus saving critical material by taking advantage of the wearing properties and resistance to thermal shock offered by this method.

For further information on this, or other Penchlor FCC Cement uses, write Pennsylvania Salt Manufacturing Company, Industrial Chemicals Department, 1000 Widener Building, Philadelphia 7, Pa.

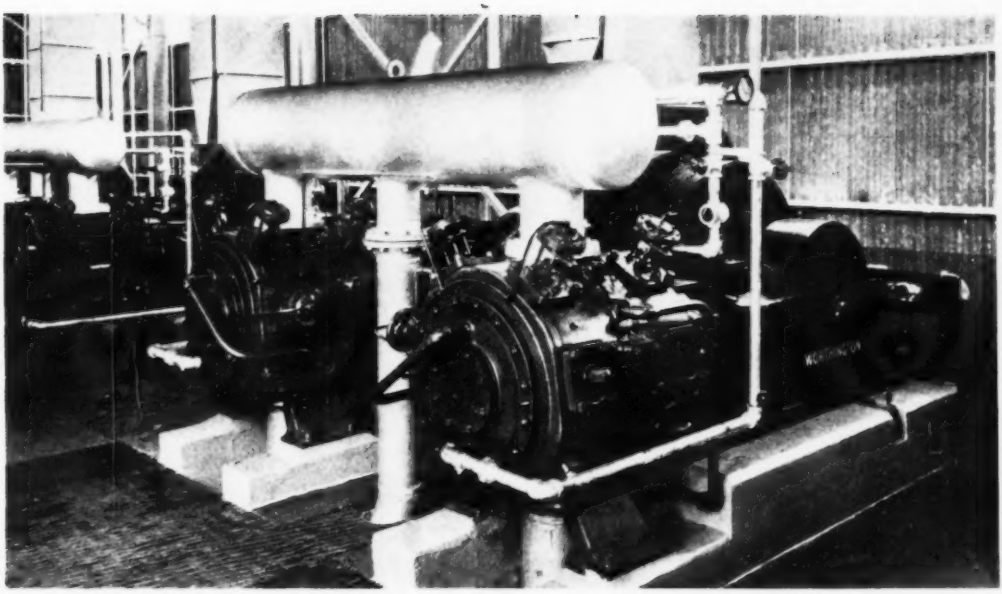
**PENNSALT CHEMICALS**

for Industry • Agriculture • Health • Home

*Progressive Chemistry for over a Century*

**5 Important Advantages of Penchlor Grid Linings**

1. Replace more expensive high-alloy steels.
2. Fast "return to service"—short curing time.
3. Long life. Penchlor Linings have been in service for over 3 years without extensive repair . . . over twice the life of former linings.
4. Penchlor gains hardness while in service.
5. Penchlor offers total resistance to many corrosives.



# A New Cracking System at Socony-Vacuum
# ...BUT THE SAME COMPRESSORS

When Socony-Vacuum needed to modernize its catalytic cracking plant in Buffalo, it put in the thermofor process.

To compress hydrocarbons for the process, Socony-Vacuum selected Worthington DC compressors. Why?

Because—the three Worthington compressors on the old Houdry system performed successfully . . . since 1939.

So . . . in addition to these three, Socony-Vacuum now has four more compressors working on the Thermofor unit. One of these four (not shown in the picture) is a 4-cylinder tandem compressor with a unique control system permitting it to operate on either low or high pressure service.

This case illustrates not only the *dependability* of Worthington compressors but also the *adaptability* of the Worthington line to all refinery requirements—all types of gases, all pressures, all capacities. In addition, Worthington provides the broadest line of pumps, engines, refrigeration equipment and other petroleum processing machinery.

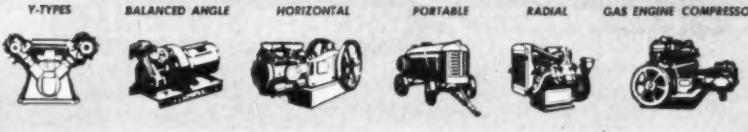
Investigate *more worth in Worthington*. Worthington Pump and Machinery Corporation, Compressor Division, Buffalo, New York.

**WORTHINGTON**

**COMPRESSORS**

24K.1.4

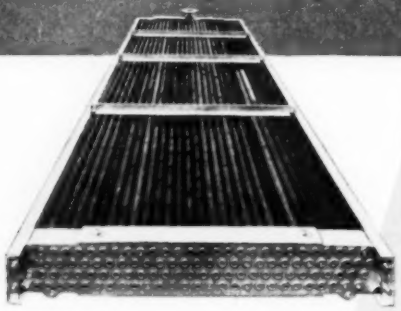
NO OTHER COMPRESSOR WILL OUTPERFORM A WORTHINGTON



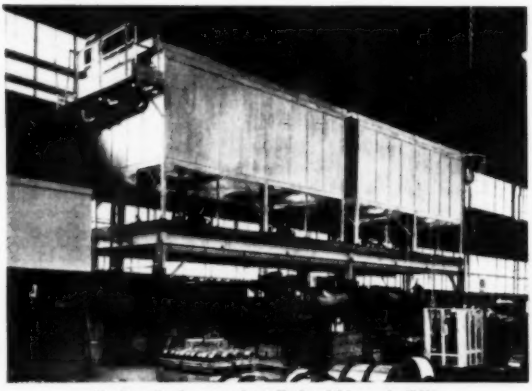


(To obtain more data on advertised products see page 1164)

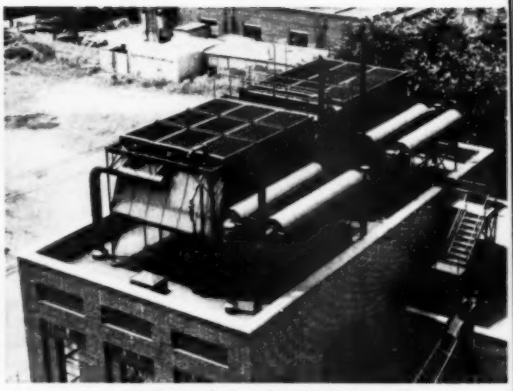
# FIN-FAN
## AIR-COOLED HEAT EXCHANGER



G-R K-Fin Air-Cooled Sections used in the Fin-Fan Exchanger



Fin-Fan Exchanger installed within a building



Fin-Fan Exchanger installed on a roof

Large Fin-Fan installation on the ground

GRISCOM-RUSSELL

# AIR...the only cooling and condensing medium that's...

- **FREE**
- **LIMITLESS**
- **UNIFORM**
- **DEPENDABLE**

Every plant designer, construction engineer and maintenance man knows the expenses, complications, and difficulties of water-cooled heat exchangers . . . the required piping, pumping, treatment and disposal . . . the likelihood of corrosion, scaling and freeze-ups . . . the uncertainty of sustained adequate supply.

All these problems are being avoided by plants in every section of the country which use AIR as the cooling or condensing medium . . . in FIN-FAN Air Blast Exchangers.

These exchangers, developed jointly by The Griscom-Russell Co. and Fluor Corp. Ltd., are self-contained package-type units. They include G-R K-Fin Heat Transfer Sections with Fluor air circulation equipment, all mounted in a sturdy compact structure.

You can use Fin-Fan Exchangers on practically any cooling or condensing service. You can put them anywhere . . . on the ground, on a roof, or within a building. You can use a single installation for two or more heat transfer duties.

And these are only some of the many Fin-Fan benefits and advantages. Get the whole story of this important development in heat transfer apparatus . . . write for bulletin and ask for specific recommendations on Fin-Fan for your cooling and condensing needs.

**Some of the many services on which FIN-FAN EXCHANGERS are being used**

- Exhaust steam condensing
- Engine jacket water cooling
- Engine oil cooling
- Oil cooling for large gear boxes, speed reducers, etc.
- Gas compressor inter and after cooling
- Process gas cooling
- Solution cooling
- Quenching oil cooling
- Still reflux condensing
- Final overhead condensing and cooling
- Refrigeration system condensing
- Gas treating and purification system condensing and cooling

**THE GRISCOM-RUSSELL CO. MASSILLON, OHIO**

GR-257

**GRISCOM-RUSSELL: PIONEERS IN HEAT TRANSFER APPARATUS**

# Now available to refiners...

# IONAD 17

## Field tested for 3 years in thousands of domestic installations

FILTER A FILTER B

**What this filter screen test proves:** Shown are 100-mesh screens from two full-scale tests run simultaneously. In each test 125 gallons of No. 2 fuel oil were circulated intermittently through a domestic fuel oil pump for 28 days. One test, containing Ionad 17, was circulated through Filter A. The other test, using the same oil, without Ionad 17, was circulated through Filter B. The two filter screens are a dramatic proof of the anti-clogging action of Ionad 17.

These results have been duplicated in thousands of domestic fuel oil burners. *Not a single case of failure due to a clogged screen was reported* in the three years Ionad 17 has been used.

# IONAD 17

# Shell's anti-clogging fuel oil additive

# IONAD 17

## The essential ingredient that prevents clogging of filter screens

CLOGGING OF OIL BURNER and diesel filter screens, a major cause of equipment failure, now can be a thing of the past. Ionad 17, an oil soluble concentrate, when added to oil stocks, eliminates clogging of filter screens resulting from the agglomeration of tars and resin-forming compounds.

## How Ionad 17 saves money

Ionad 17 is readily soluble in the various grades of domestic fuel and diesel oils. It reduces the incompatibility of fuel oil stocks, and minimizes further treatment. It has been found that in many refineries the cost of Ionad 17 is more than offset by savings in treatment.

The addition of Ionad 17 to bulk stores prevents the formation and build-up of deposits which form on tank bottoms. You save money in the reduced frequency of storage tank cleanings.

All of these advantages are now available to refiners. Technical information on Ionad 17 may be obtained from the nearest Shell Chemical office.

**SHELL CHEMICAL CORPORATION**

CHEMICAL PARTNER OF INDUSTRY AND AGRICULTURE

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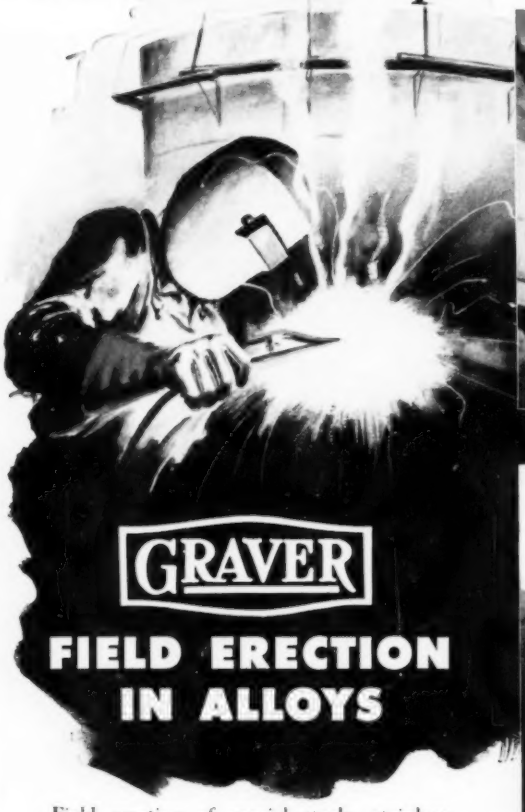
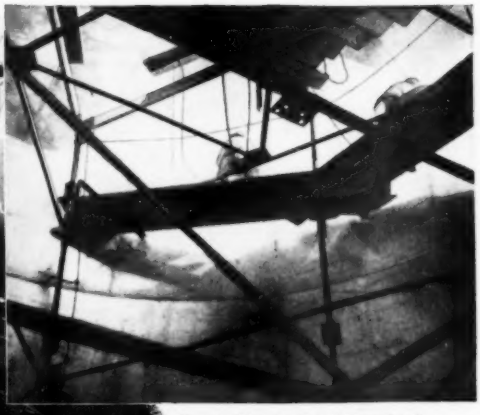
# *Another example of* GRAVER *skill*



GRAVER

**FIELD ERECTION IN ALLOYS**



Graver welders at work on field erection of nickel-clad chemical tanks.

Exterior view of two butt-welded, nickel-clad storage tanks. Capacity: 2,100 bbls. each. Size: 25' O.D. x 24'.

Two Graver nickel-clad tanks adjacent to those recently erected. Same capacities and dimensions as new tanks above.

Field erection of special steels, stainless, alloys, clads and aluminum requires special techniques and specially trained crews. Graver is one of the few fabricators who can offer the surety of successful, long-lasting construction of alloy vessels and tanks. Graver's experience in this work is as old as the use of alloys. As an example, photographs are shown of a recent site-erection of two nickel-clad tanks for a large chemical company. This job is significant because it is a repeat order duplicating a previous pair of nickel-clad tanks of the same size for the same purchaser.

**GRAVER TANK & MFG. CO., INC.**

EAST CHICAGO, INDIANA

NEW YORK • CHICAGO • PHILADELPHIA • WASHINGTON
DETROIT • CINCINNATI • CATASAUQUA, PA.
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Know your class
Do's and don'ts for better piping service
Variations in stem operation of gate, globe, and angle valves
The different types of bonnet joints on gate, globe, and angle valves
PIPING POINTERS
CRANE

# Just Out!

## NEW 36-PAGE EDITION OF

# PIPING POINTERS

### ...a bigger, more helpful handbook for training maintenance workers

You asked for ¼ million copies of the last edition of Piping Pointers. You found it a big help in training beginners and refreshing veterans in your piping crews. The bigger and better edition is just out—changed in appearance but not in purpose. Crane again offers this booklet—to help keep your piping systems at peak efficiency.

Piping Pointers talks facts . . . not theory. Thoroughly covers the fundamentals of good, sound, everyday piping practices . . . in easy-to-grasp, nontechnical language. Its many "how-to-do-it" features are illustrated for easy understanding.

Mistakes in piping installation and maintenance cost more today. Piping Pointers can help your men avoid them. Just ask your Crane Representative for a copy.

### PARTIAL INDEX TO PIPING POINTERS

**HOW TO** choose valves for every service . . . install valves . . . read reducing fittings . . . make up screwed joints . . . assemble flanged joints . . . make up solder joints . . . install pressure regulators . . . use vent and drain valves . . . avoid steam trap trouble . . . save on pipe joints and materials . . . handle piping tools.

**plus THE CRANE VALVE SELECTION GUIDE** which saves time and effort in selecting valves for common piping services.

**PIPING POINTERS 16-mm SOUND FILM**
**Free Usage for Group Training**

A 30-minute motion picture that dramatizes the fundamental information in the Piping Pointers Manual. Ideal for classroom or plant training groups. Available on request through your local Crane Branch.

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CRANE CO., *General Offices:*
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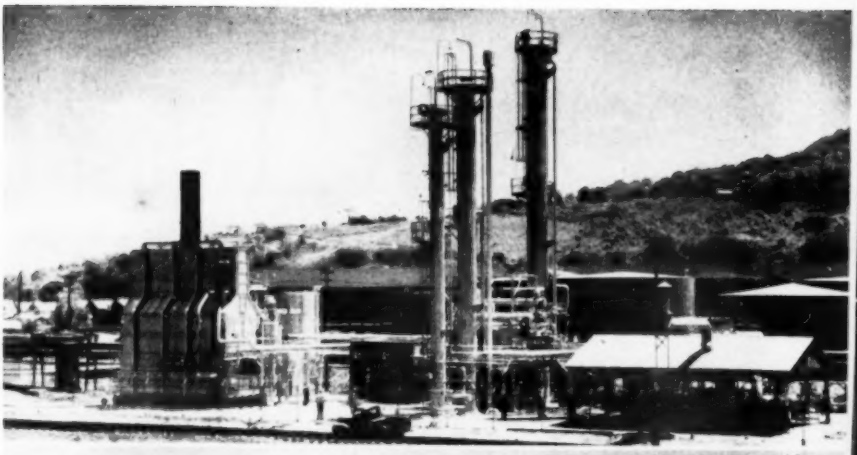
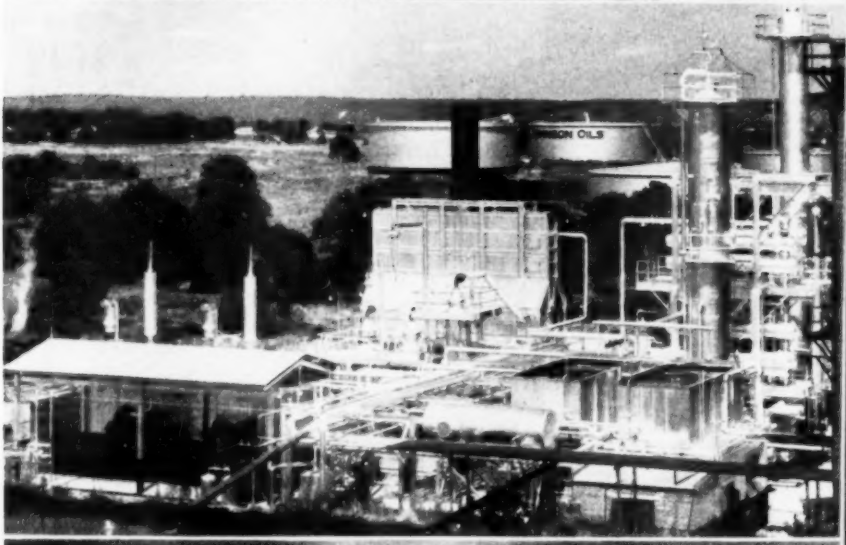
*Branches and Wholesalers Serving All Industrial Areas*

**VALVES • FITTINGS • PIPE • PLUMBING • HEATING**

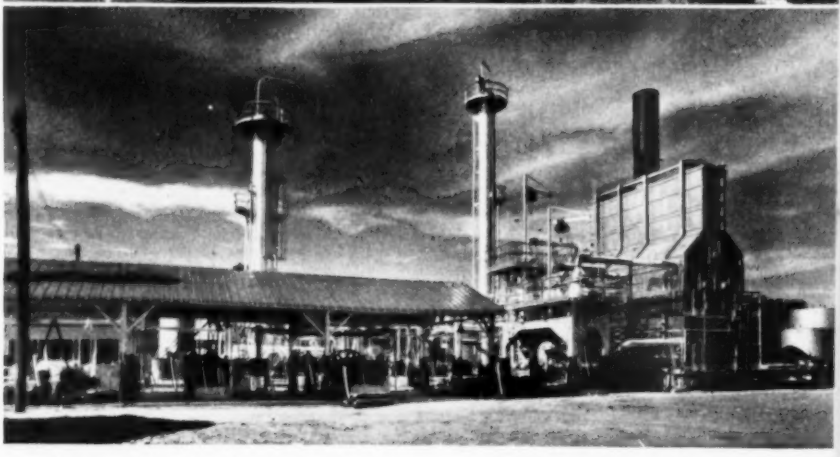
**KENDALL REFINING CO.**
Bradford, Pa.



**JOHNSON OIL REFINING CO.**
Cleveland, Okla.



**MIDWEST REFINERIES, INC.**
Alma, Michigan



## NOW ON STREAM...
## THREE NEW UOP
## PLATFORMING UNITS

On stream in less than a year from the date the contracts were signed . . . the new Kendall, Johnson, and Midwest Platforming Units provide proof of Procon resources and skill.

Even though defense requirements presented definite problems, Procon was able to procure materials and equipment without serious delay . . . and having ample manpower and construction facilities available, quickly completed the jobs.

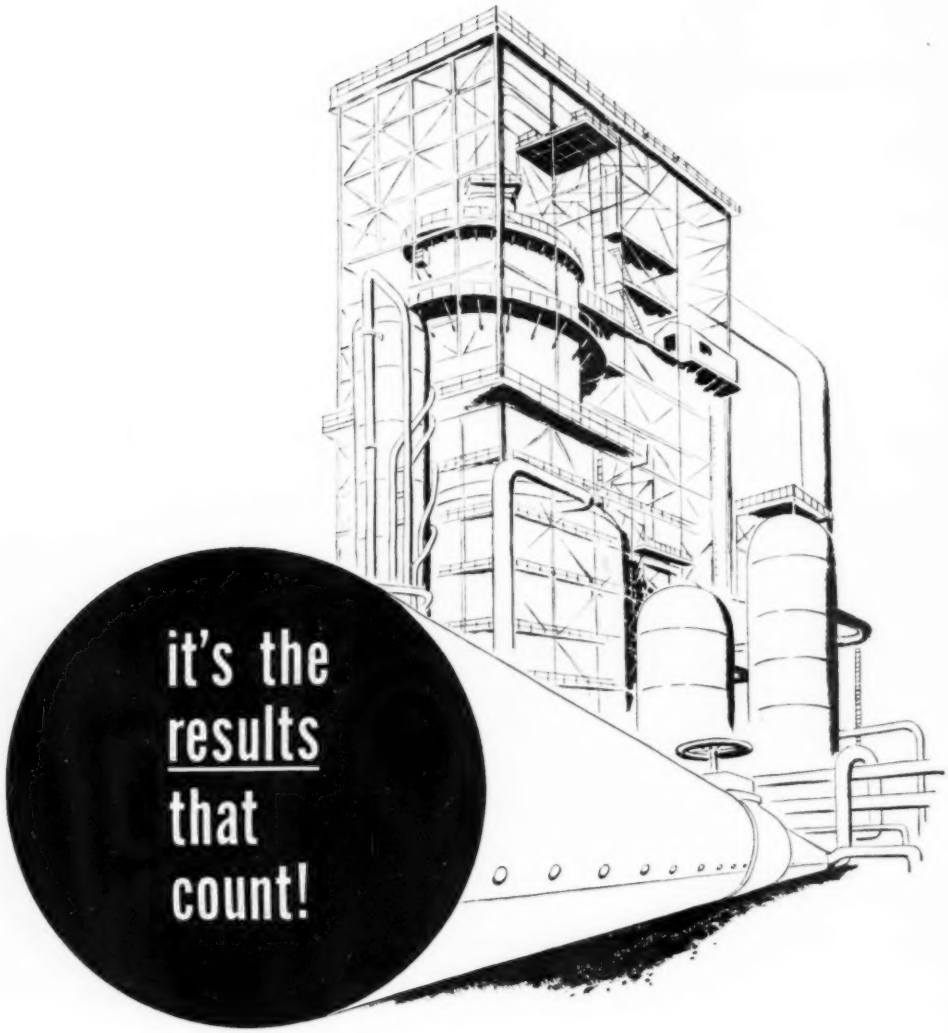
# BUILT BY PROCON

Staffed and equipped to handle any process construction job, Procon offers a *complete service* to the petroleum refining and petro-chemical industries. If your plans call for new construction or expansion of existing facilities, discuss your requirements with Procon.

PROCON *Incorporated*

**PROCESS CONSTRUCTION**

75 EAST JACKSON BLVD., CHICAGO 4, ILLINOIS



# it's the results that count!

Top results are insured through the uniform quality of Davison synthetic fluid-type cracking catalysts. Years of experience and research make it possible for Davison to better control physical characteristics and maintain chemical purity of their catalysts. Your requirements can now be supplied in either microspheroidal (M-S*) or ground (DA-1*) form . . . both available in various average particle sizes.

The Davison "D" also stands for dependability. Likewise, you can depend on Davison facilities for the development and production of catalysts for your specific processes.

*T.M.T.D.C.C.

*Progress Through Chemistry*

**THE DAVISON CHEMICAL CORPORATION**

*Baltimore 3, Maryland*

**PRODUCERS OF:** CATALYSTS, INORGANIC ACIDS, PHOSPHATES, PHOSPHATE ROCK, SILICA GELS, SILICOFLUORIDES AND FERTILIZERS

# Alcoa Heat Exchanger News

Rearmament needs severely limit the manufacture of aluminum heat exchanger tubes. But we realize that the purchase of refinery and processing equipment requires long study of economic and performance factors. That is the reason for this message.

Published by Aluminum Company of America

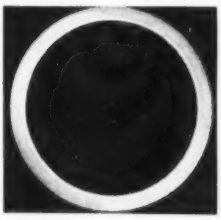
## Skelly Oil Company Saves 50%

### IN TUBE COSTS ON AIR COOLED EXCHANGERS

At their Eunice No. 2 gasoline plant near Eunice, New Mexico, Skelly Oil Company has installed a "Fin-Fan" air-cooled unit equipped with "aluminum tubes" and "aluminum fins" as a condenser for "Still Overhead Vapors." The company's engineers chose this type of condensing equipment because the atmosphere contained hydrogen sulfide and the vapors contained hydrogen sulfide and water in corrosive quantities. In addition there was a shortage of suitable cooling water. Aluminum tubes and fins were preferred to steel or Admiralty tubes with copper fins because of their resistance to hydrogen sulfide corrosion and lower investment cost. In this particular installation Fluor Fin-Fan designed equipment with Griscom-Russell K finned aluminum tube sections was used. The aluminum tubes are rolled into cast-iron headers and no cathodic protection has been necessary. These units have been in service for over two years—show no sign of corrosion—should last 12 to 15 years based on past experience with aluminum.

## ALCLAD TUBES . . .

### a bargain in cooling water corrosion resistance



#### HOW THEY WORK

The thin zinc-aluminum alloy internal layer galvanically resists corrosion of the base aluminum alloy structure of the tube—acts like a "built-in" anode. Corrosion is confined within the integral cladding layer. Even when large areas of the Alclad coating have been destroyed by electrolysis, the rest of the coating still protects the exposed alloy core. Alclad Tubes have withstood such corrosive attack for more than 17 years.

#### WHAT THEY COST

Foot for foot, metal for metal, Alclad Tubes cost less than any other tubes except bare aluminum. 20% less than ordinary steel. 47% less than Admiralty brass. 83% less than stainless steel.

### ALCOA OFFERS BOOKLET

This 24-page booklet will answer many of your questions about Alcoa Tubes. It covers fabrication techniques, alloy selection, chemical and petroleum applications. It describes tube cleaning, inhibitors, cathodic protection. It contains complete information on fluid flow and heat transfer. There are formulas, tables and specification data. Write for your free copy today. ALUMINUM COMPANY OF AMERICA, 1863 K Gulf Building, Pittsburgh 19, Pennsylvania.

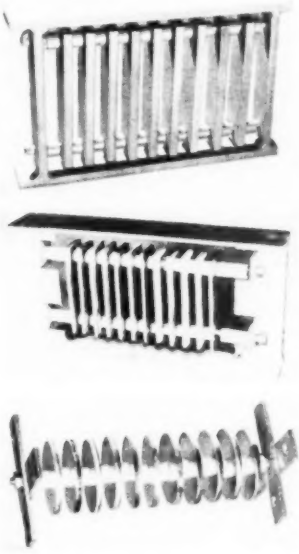
# *How* INCO HIGH-TEMPERATURE ENGINEERS SEEK THE ANSWER TO A PROBLEM

**Inco High-Temperature Service is ready to assist you on metal problems at high heat with all its knowledge of high-temperature metal performance.**

In laboratories at Bayonne, N. J., and Huntington, W. Va., creep tests measure the load-carrying ability of various alloys at temperatures up to 2100 F.

Other tests are constantly adding to the knowledge of how metals behave under varying degrees of heat and corrosive conditions. These laboratory studies are extended by field work. Investigation of metals serving in high-temperature applications reveals why some metals stand up where others fail. Corrosion is often the most important cause of damage and failures.

In field work Inco Engineers make use of High Temperature Corrosion Test Racks, shown above, to observe the effects of corrosive atmospheres. These carry a selection of different alloys which are placed right in the existing equipment to give a direct comparison of the various materials under actual service conditions.



High-Temperature Test Racks are supplied in different styles or shapes when necessary for placing in the corrosive atmosphere. All are basically a selection of *different* metals — which are exposed simultaneously to the corrosive conditions.

After removal, the samples of various alloys are examined. The suitability of the alloys or the degree of damage is evaluated from the appearance of scale, the depth of attack, and other data derived from metallographic study and mechanical testing.

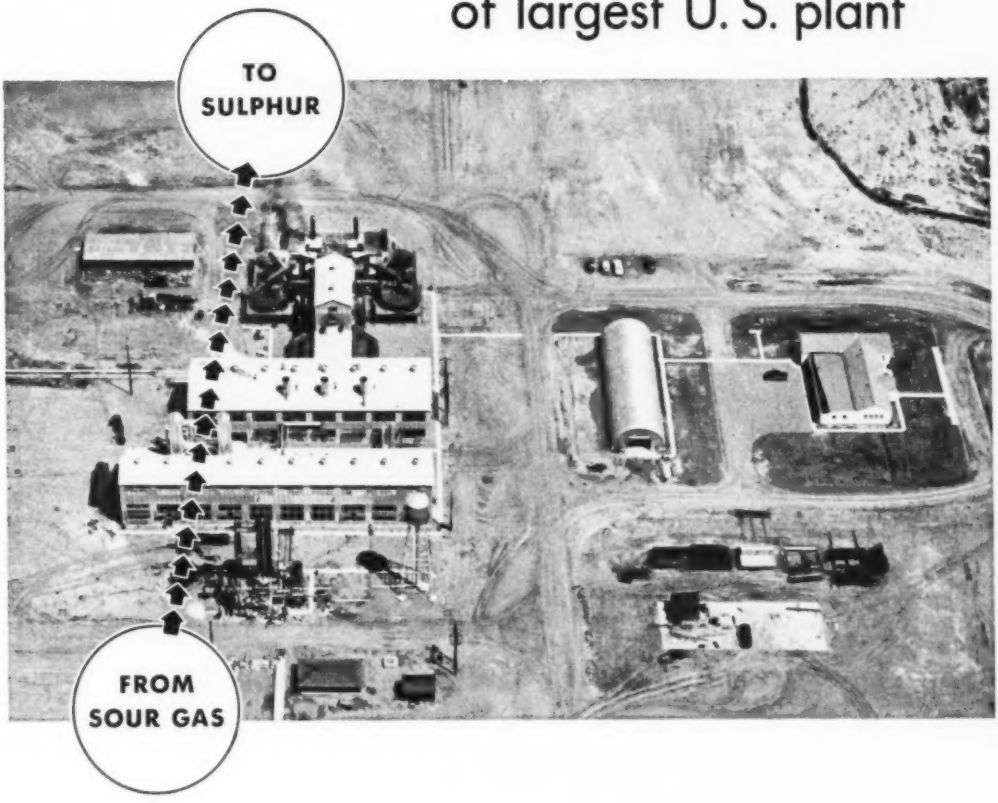
In your high-temperature problems, whether in present activities or in new projects, Inco High-Temperature Engineers will be glad to work with you. Let them send you the High-Temperature Work Sheet . . . to aid you in explaining your problem. Then see if Inco Engineers cannot help solve your difficulty.

Send for your copy of this new High-Temperature Work Sheet; it simplifies gathering the full story of your problem.

EMBLEM OF SERVICE

**THE INTERNATIONAL NICKEL COMPANY, INC.**
*67 Wall Street, New York 5, N. Y.*

# **Girdler** handles construction of largest U. S. plant




BEFORE this new Wyoming plant of the Texas Gulf Sulphur Company went in operation, large volumes of "sour" natural gas released at the wells of the Worland Oil Field had to be burned and wasted as the gas contained about 30% hydrogen sulphide, an evil smelling and poisonous gas.

Then came plans to turn waste products to profits—by separating the hydrogen sulphide, converting it to sulphur and selling the purified gas.

The prime contract for engineering and constructing these facilities, embracing a gas purification plant, sulphur recovery plant, water softening plant, sulphur storage and loading equipment, and buildings, was handled by The Girdler Corp.

Thus Girdler's wide experience in gas processing is once again paying dividends—in the country's largest plant of its type. Elemental sulphur, vital to the mobilization effort, is produced at the rate of 300 tons a day. And the flexibility of the plant permits coordination of sulphur, gas, and oil production at the optimum over-all rate.

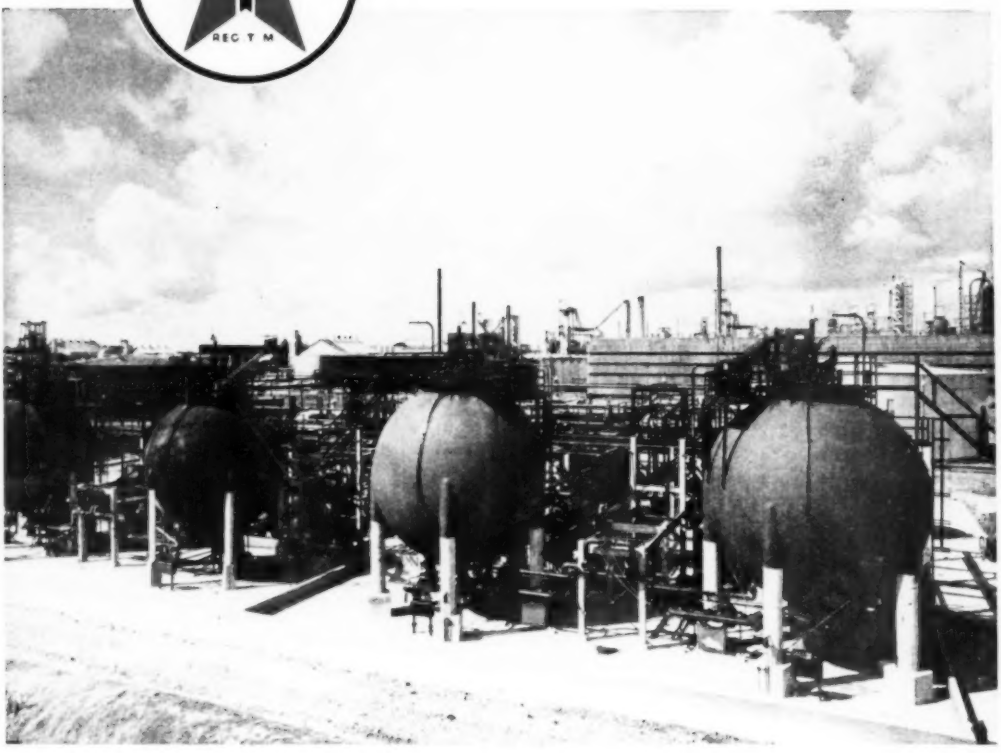
If efficient gas processing is necessary in your operations, put our experience to work for you, too. The Girdler Corp., Gas Processes Division, Louisville 1, Kentucky.

*Write for bulletin describing our services. The Girdler Corporation designs and builds plants for the production, purification or utilization of chemical process gases; the purification of liquid or gaseous hydrocarbons; the manufacture of organic compounds.*

THE GIRDLER CORPORATION
Gas Processes Division

TEXACO
REG T M

*another leading refiner who desalts with PETRECO*



Illustrated above is one of the largest batteries of Petreco Electrospheres in the world. This installation is located at the Port Arthur, Texas, refinery of The Texas Company. In refinery after refinery, Petreco Desalters have proved their pay-out by increasing on stream time, increasing expected unit throughputs and by reducing maintenance and repair costs. These advantages derived from charging desalted crudes also entail benefits such as reduced furnace plugging, longer tube life, maximum exchanger efficiency, less corrosion in the topping section, clear water bleed, salvaged waste oil and trouble-free, automatic desalter operation. For the best in desalting performance and service, get Petreco.

**PETROLEUM RECTIFYING COMPANY** | 5121 South Wayside Drive, Houston 3, Texas
1390 East Burnett Street, Long Beach 6, California

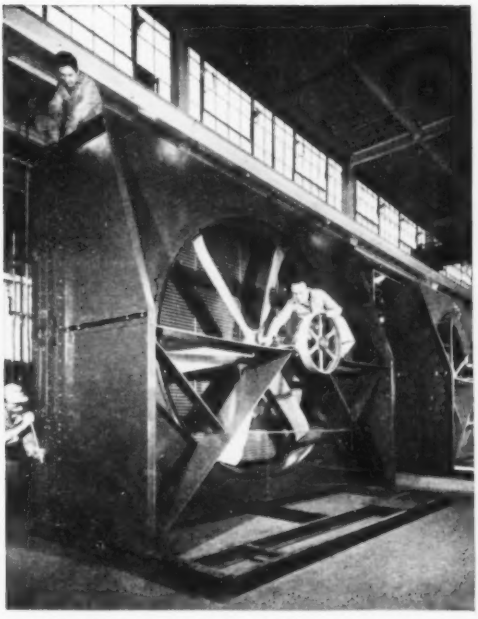
*PETRECO OFFERS COMPLETE DESALTING SERVICE AND FACILITIES*

# PETRECO

**SPECIALIZED *Electric* PETROLEUM PROCESSES** | DESALTING / DEHYDRATING

PR 51 4

Headering on Brazed Aluminum Heat Exchangers is designed to fit the job.



This Fluid Cooler uses tube-and-fin surface for cooling jacket water.

## Gas or Liquid Cooling, Heating, Condensing, Vaporizing

# Trane Heat Exchangers Serve Every Process

When you think of heat transfer, think of Trane. Whether your problem is small or large. Whether you want to cool diesel jacket water or condense hydrocarbon fractions. Whether exchanging or removing heat. Whatever your heat transfer problem, you may find the solution in the complete Trane Heat Exchanger line.

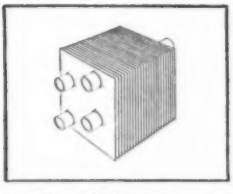
The Trane line includes three basic types of surface:
**1. Fin and tube. 2. Shell and tube. 3. Brazed aluminum.**

The fin-and-tube unit is fabricated from flat plate-type fins attached to seamless tubing with a solderless mechanical bond that assures uninterrupted flow of heat. Tube sizes can be varied from $^3/_8$" to 1". Various fin spacings are furnished. Available in every type of metal that can be formed. This surface is offered separately, in built-up units, in shell-and-fin-tube units or bare tube units for exchanging heat.

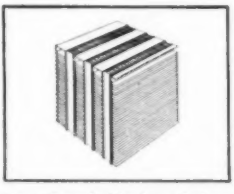
For removing heat there is the Trane Fluid Cooler which extracts heat from liquids such as water or oil. A typical application is cooling diesel or gas engines.

Brazed aluminum, a revolutionary new heat transfer surface, is fabricated entirely from aluminum in a special brazing process perfected by Trane. It can be used for gas-to-gas, gas-to-liquid or liquid-to-liquid transfer. It will meet practically any specification of heat transfer, pressure drop, volume velocity of fluids. Units may be built with as many as five different streams for gas or liquid. Streams may be taken off at any point.

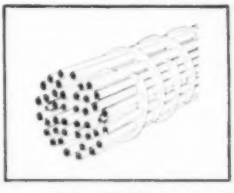
With these three basic types of heat transfer equipment, Trane offers heat exchangers for cooling gas or liquids, engine cooling, vapor condensing and countless other processes in the petroleum industry. If you have a knotty heat transfer problem, contact the Trane Sales Office nearest you or write direct.



**Trane Fin-and-Tube Surface** used principally for liquid to gas heat transfer. When incorporated in shell can be used for liquid to-liquid exchange.



**Trane Brazed Aluminum Surface** only one of infinite arrangements possible for gas to gas, gas to liquid or liquid to liquid heat transfer.



**Trane Shell-and-Tube Surface** conventional tube bundle arrangement for heat transfer between liquid to liquid or liquid to gas. Trane has all three surfaces.

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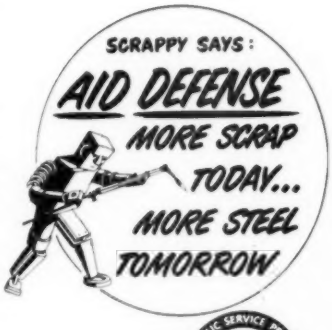
Every pound of unused iron and steel you have is needed to help steel mills and foundries keep production up to rising capacity.

Scrap inventories are alarmingly low. Mills that normally maintain inventories of several months, are now down to a day-to-day basis. Shutdowns are threatened.

One way we can maintain desired level of both military and civilian production is for you to *dig up* and *turn in* your iron and steel scrap now.

Get in touch with your local scrap dealer and write for the free booklet, "Top Management: Your Program for Emergency Scrap Recovery" to Advertising Council, 25 W. 45th St., New York 19, N. Y.



NON-FERROUS SCRAP IS NEEDED, TOO!

***This advertisement is a contribution, in the national interest, by***

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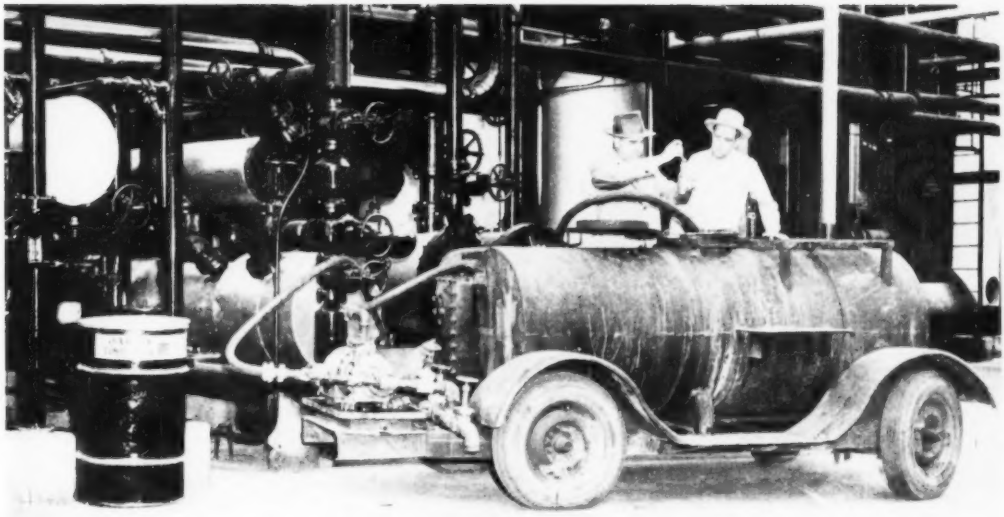

# Refinery's own crew cleans heat exchangers in place

No outside help needed to do *this* job. This refinery saves money, time, tubes by cleaning and descaling heat exchangers the simple Oakite way.

Here's how: First circulate a solution of recommended Oakite cleaner through oil side to remove carbon, wax, oil deposits. Then circulate Oakite Compound No. 32 through water side to remove scale and rust. Method quickly restores unit to peak heat transfer efficiency. No expensive dismantling. No tedious steam lancing.

Your Oakite Petroleum Service Representative will gladly help you set up your own heat exchanger cleaning system. Call him today. Or write Oakite Products, Inc., 50D Thames St., New York 6, N. Y. for *free* booklet.

FREE BOOKLET F7629 gives full details on cleaning heat exchangers; cleaning towers; reconditioning drums; cleaning tank cars; reconditioning salvage parts. Get your copy today!

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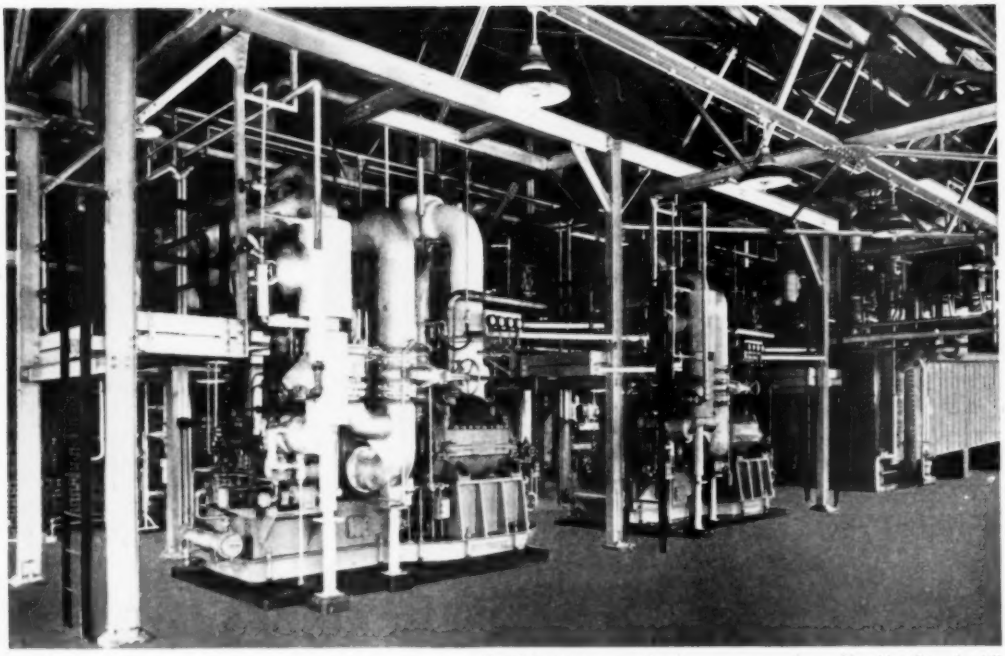

*Two Worthington centrifugal compressors, each capable of handling the full 380-ton load; at right, one of the three Worthington chilling machines.*

# How Socony-Vacuum Gives Wax the Cold Shoulder

For the new addition to its Paulsboro refinery, Socony-Vacuum and its process engineers and constructors, E. B. Badger & Sons Co., found the *right* chilling equipment in Worthington's complete line.

Here's how this modern plant meets the 380-ton refrigeration load required by its solvent dewaxing process.

Plant propane is alternately condensed and vaporized in a closed cycle. The liquid propane, boiling at a low pressure and a constant temperature of minus 25F, surrounds the tubes in the Worthington inclined chiller through which the wax-bearing mixture is pumped.

Propane vapor, released in the chiller, is withdrawn to be compressed, with two liquid intercooling stages, from suction conditions of about 8 psig to a condenser pressure of 215 psig.

The compressors are four-stage Worthington centrifugal compressors. They are driven by 8420 rpm Worthington steam turbines which take steam from the plant mains at about 400 psig and exhaust at 40 psig back pressure to be used for heating purposes in other parts of the solvent recovery process.

Important installations such as this one are most likely to include Worthington refrigeration, because Worthington offers complete cycles for petroleum, chemical and petro-chemical applications, including centrifugal charge gas compressors for high pressure, condensers, coolers and exchangers.

Take advantage of the *more worth in Worthington*. Write for bulletin to Worthington Pump and Machinery Corporation, Air Conditioning and Refrigeration Division, Harrison, New Jersey.

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DU PONT REG. U.S. PAT. OFF.

# PETROLEUM CHEMICALS DIVISION NEWS

DU PONT REG. U.S. PAT. OFF.

October ★ One of a Series of Interest to the Petroleum Industry ★ 1951

## SALUTE TO THE PETROLEUM INDUSTRY ON OIL PROGRESS WEEK

Just as Spindletop roared in with a mighty gusher 50 years ago, so has our modern civilization—powered by petroleum products—surged ahead.

More and better petroleum products have paved the way to progress in industry, in transportation, in farming, in home conveniences. And today, such revolutionary products as detergents, plastics and synthetic rubber play an important role in our everyday life—thanks to the basic materials supplied by an alert, progressive petroleum industry.

Du Pont is proud of its contributions to oil progress, too . . . with explosives, paints, neoprene and many other products . . . and proud of its work with refiners in developing additives that make for superior fuel performance.

## Du Pont "Zerone" and "Zerex" Formulated to Meet Varying Customer Needs

Climate, altitude, driving conditions and mechanical design of the car all have a bearing on the type of anti-freeze a motorist needs for efficient cooling system operation. That's why Du Pont makes two distinctly different types of anti-freeze—"Zerone" and "Zerex." Both are well known to millions of motorists the country over.

"Zerone" is made to meet the requirements of 4 out of 5 motorists for complete winter protection. It contains a chemical-type rust inhibitor to protect the radiator from corrosion.

"Zerex" is specially made for such extraordinary conditions as high opening thermostats, high altitudes, heavy-duty driving and temperatures colder than 30°F. below zero. Its chemical rust inhibitor helps to keep the entire cooling system clean and free from rust and corrosion.

In addition, Du Pont has prepared a cooling system manual to help service station operators build additional business with a complete cooling system service. It deals with many common cooling system problems and gives complete instructions for both summer and winter conditioning. The manual is available through wholesale distributors of "Zerone" and "Zerex."

# Broad Petroleum Additives Program Aims at Providing Maximum Assistance for Refiners

How CAN Du Pont's extensive chemical research and manufacturing experience be of greatest help to the refinery industry?

The answer to that question, posed more than a quarter century ago, ultimately led to Du Pont's development of a complete line of gasoline additives . . . tetraethyl lead compounds, dyes, antioxidants and Metal Deactivator. In addition, Du Pont set up a broad service program to help refiners and marketers obtain maximum uniformity, economy and efficiency in the use of these additives.

THE JACKSON LABORATORY, located near the Du Pont Chambers Works TEL manufacturing area, was the scene of many early developments in TEL and other petroleum additives.

Du Pont's close cooperation with the petroleum industry started on additive problems back in the early 20's with the development of tetraethyl lead. The safe commercial manufacture of this important antiknock compound was first accomplished by Du Pont scientists and, until recently, Du Pont was the sole manufacturer of this product.

At about the same time, dyes also became an important factor in gasoline marketing. This was brought about in part by the Surgeon-General's recommendations that gasoline containing TEL must be identified by distinctive coloring.

Since Du Pont had been developing dyes as early as 1915, when World War I cut off the German supply, the Company was again able to make a substantial contribution to the petroleum industry. For Du Pont had already poured millions of dollars and years of research into the task of perfecting uniform, economical dyes for many uses.

Today, Du Pont manufactures and sells gasoline dyes conforming to the rigid standards that have been established through many years of research and experience.

But Du Pont's interest in gasoline additives did not stop with TEL and dyes alone. The problem of keeping cracked gasolines gum-free during long periods of storage brought about the development of Du Pont Gasoline Antioxidants. Sulfuric acid, both costly and contributing to treating losses, had previously been used for this purpose. With antioxidants, however, due to

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OVER

DU PONT

# PETROLEUM CHEMICALS DIVISION NEWS

DU PONT

CONTINUED *Additives Program*

their effectiveness even in small concentrations, refiners were able to produce finished gasoline at lower treating costs.

Today, antioxidants are almost as important to the production of high quality gasoline as is tetraethyl lead. And they are especially important to the defense effort because of the oxidation problems involved in stockpiling gasoline.

Still alert to problems and desired improvements in refining, Du Pont added Metal Deactivator to its line. Until 1937, there had been little need for this product. Then copper sweetening came into the picture. This was a distinct advance in refining, but, unless handled with care, traces of copper might remain in the sweetened gasoline. This copper is a highly active catalyst in the oxidation of the unsatrated constituents in the end product.

Obviously, there was a need for deactivating even minor traces of copper —and Du Pont Metal Deactivator met this need. Thus more refiners have benefited from the advantages of this process.

Du Pont has set up a complete program of technical services for the petroleum industry with a large staff of

SINCE 1923, Du Pont has manufactured TEL in these buildings at the Chambers Works, Deepwater, N. J. Here, the first safe method of producing tetraethyl lead compounds was accomplished on a commercial scale.

competent personnel especially trained in the use of all gasoline additives. Services also include promotion and dealer training aids for marketers, as well as safety, medical and research help for refiners. And besides specialized work on fuel and lubricant problems at the Petroleum Laboratory, Du Pont petroleum chemicals are backed by broad Company research facilities, that rank with the most extensive in the world.

## PIONEER IN GASOLINE ADDITIVES RESEARCH

FREDERIC BAXTER DOWNING is assistant director of the Jackson Laboratory. He is one of the many Du Pont men who worked on the early development of gasoline additives. Today, he directs the research group working on tetraethyl lead, and other groups engaged in research work on neoprene, fluorine and general organic chemicals.

Before joining the Du Pont Company in 1917, he was a chemist with the Aluminum Company of America and the Champion Fibre Company of Canton, North Carolina.

Mr. Downing graduated from Cornell University in 1916 with a B.S. in chemistry. He is a member of the Society of Automotive Engineers, as well as the American Chemical Society, the American Assn. for the Advancement of Science and the Franklin Institute.

**Frederic B. Downing**

## Reprints of Du Pont Paper on "Antiknock Antagonists" Now Available

Reprints of a paper "Antiknock Antagonists," which appeared in the March 1931 issue of Industrial and Engineering Chemistry, are available through Petroleum Chemicals Division district offices. The paper was prepared by H. K. Livingston of the Du Pont Jackson Laboratory.

In the paper it is stated that the antiknock efficiency of tetraethyl lead and related compounds is decreased by antagonists which limit the utility of the antiknocks and lead to economic waste, unless the nature of the antagonists is recognized and their concentrations in gasoline are reduced to the minimum.

A proposed mechanism of antiknock action shows which compounds will have a harmful effect on the octane number of leaded gasolines and permits prediction of the economic advantage to be expected from their removal. The proposed mechanism also provides a basis for further work leading to an ultimate understanding of the chemical processes involved in the knock phenomenon and in knock suppression by chemical antiknocks.

## *LITERATURE AVAILABLE*

The following is a partial listing of many Du Pont bulletins, reports, technical papers, booklets and other aids available to you. Address requests to your nearest Du Pont Petroleum Chemicals Division District Office.

Antiknock Antagonists—by H. K. Livingston, Jackson Laboratory.

Possible Mechanisms By Which Combustion Chamber Deposits Accumulate and Influence Knock
Serial A-2087a

Tank Talk — a 52-page booklet which outlines safe procedure for cleaning gasoline storage tanks. Written for the man who does the cleaning.
Serial A-1134

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. . . through Chemistry

# Petroleum Chemicals

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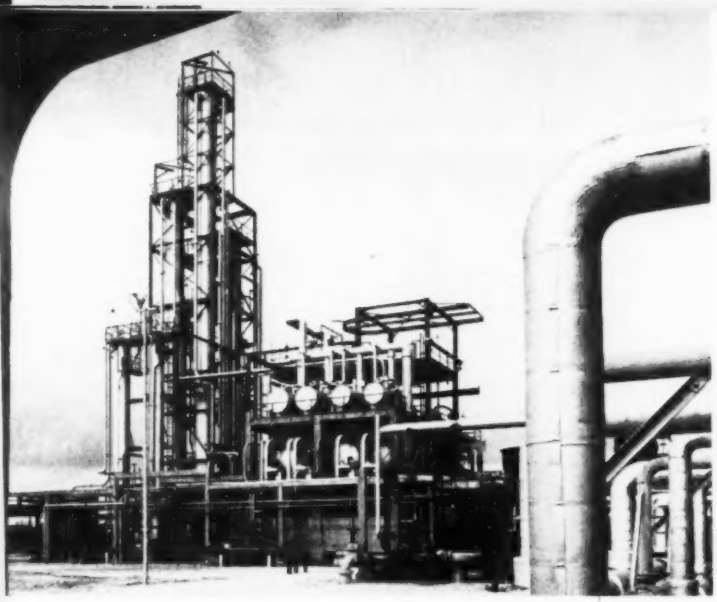


**Ethylene unit** at the Jefferson Chemical Co. plant at Port Neches, Texas. It uses refinery gases from the nearby plant of The Texas Co. at Port Arthur, and reportedly has a capacity of 175,000 lbs. of ethylene per day

# Ethylene Petrochemicals

## Today and Tomorrow: Optimism and Caution

**By W. E. KUHN, and J. W. HUTCHESON**
*The Texas Co., New York*

*This paper is copyright by The Texas Co., New York City, and is published here by permission of the copyright owner. It was presented at the annual meeting of the National Petroleum Assn. in Atlantic City, N. J., before a joint meeting of the Department of Manufacture and the Department of Standards and Tests, Sept.* 13, 1951.

BY a singular—and agreeable—coincidence, the greatest international meetings in the history of chemistry are being held in this country at the very moment a new American chemical enterprise has come of age. That enterprise is, of course, the petrochemical industry. It has altered the Gulf Coast landscape, changed our national habits, and thrown its long and increasing shadow out to the horizon of the American future.

Each aspect of this coincidence complements the other: the gathering of leading chemists from many nations focuses our attention on the fact that this is the age of chemistry, while the rapid development of petrochemical activity exemplifies practical application and the impact of a great science on everyday life.

Petro-chemistry has brought a profusion of gifts to the layman and an even more extensive profusion of potentialities to the chemist and the business man. Today, the consumer, the banker, the journalist, the investor—all are aware of the fact that petrochemistry is very much a "going concern". It has indeed come of age—but, it is far from mature.

The aim of this paper is to look ahead, to indicate what may be expected from this vital young industry as it moves rapidly toward maturity during the next decade. There is no doubt that it will produce new wonders which will continue to change the format of American life from the fuels we burn to the food we eat and the clothes we wear. The petrochemical revolution has barely begun; the outlines of its significance are only now becoming discernible.

Petro-chemistry may well be the most important industrial development of the past several decades. It is setting the pace in the fast advancing age of chemistry. It is contributing a spectacular flow of new products of superior merit which are daily pushing our living standards to higher levels. It is creating a growing payroll. It is continuously adding to national wealth and security by making greater and more efficient use of precious resources which automatically expend themselves in use.

One of the most convenient ways to get a proper perspective of an industrial enterprise is to measure its size. How big is the petrochemical industry? How big was it five, or ten, years ago? Going back for purposes of comparison, it is estimated that in 1940 there was a capital investment of $350,000,000 in petrochemical operations. Output at that time was in the order of 4,100 million pounds a year. Five years later the investment had shown a rapid growth to about $1,200,000,000 and output reflected the continued expansion by measuring 10,500 million pounds a year. Today the total investment is about $1,950,000,000 and output has advanced accordingly to a rate of 16,000 million pounds per year.

The present rate of expansion will continue for a further period of time. It probably will not

Fig. 1—Location of Petrochemical plants in the United States—1930

Fig. 2—Location of Petrochemical plants in the United States—1940

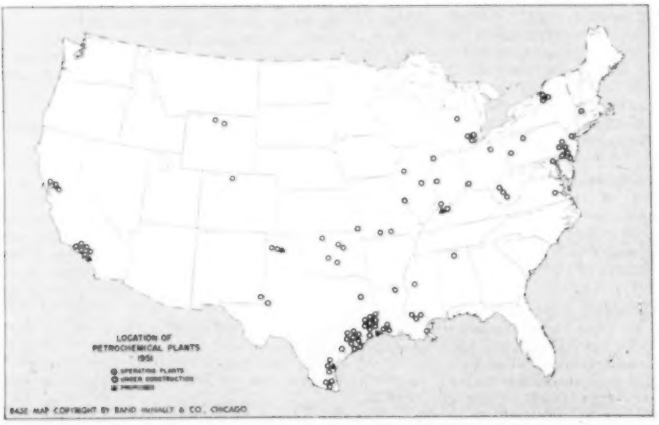



Fig. 3—Location of Petrochemical plants in the United States—1951

slacken for another decade, if then. By 1962 the industry will begin to assume its permanent position in the expanding field of synthetic chemicals.

Another valuable measure of the magnitude of this industry is the growth in the number of petrochemical plants. The accompanying maps, Figs. 1, 2 and 3, help indicate the expansion that has taken place in the last 20 years.

The total petrochemical plants of the United States a decade hence should represent an investment of four fold today's investment and likewise a four-fold increase in annual production capacity.

Let us now narrow our considerations and examine a trend taking place inside the broad framework we have just outlined. In 1945 approximately 50% of the 8,800 million pounds of aliphatic chemicals manufactured were petrochemicals. By 1950 the figure had jumped to 70% for the 13,400 million pounds of synthetic aliphatics. At the present time approximately 25% of all the chemicals being made in this country are petrochemicals. By 1962 the figure should be close to 50%.

Within the petrochemical industry, the manufacture of ethylene-derived chemicals constitutes a tremendous industry in itself. And, they are only a part of the petrochemical story. Why are the ethylene-derived chemicals playing such a big role? There are several answers. This is a good time to examine them—to discuss and look to the future of ethylene-derived chemicals. Such a discussion will serve the interests of those already in the field and those who are considering entering it.

Today a general recognition of ethylene oxide's critical role is firmly established. As of 1951 it is the most versatile building block in the petrochemical field. Basically, of course, production starts with ethylene, which is then converted to the oxide. Ethylene oxide then performs as the chemical stepping stone to a myriad number of important and vital products.

The present and the predictable future of the industry bear the stamp of great progress. But, enthusiasm for progress should not obscure certain realities and limitations. Therefore, it is necessary to examine both sides of the picture of ethylene and its derivatives. We need carefully to weigh present optimism and to evaluate the caution signs now appearing along the road to expansion.

One should first examine the prospects of any phase of an industry by assuming the optimistic view. Therefore, let us proceed optimistically by assuming the continuance of free enterprise based on vigorous competition between energetic and far-seeing companies and individuals. The possible effect of another World War is

## TABLE 1—Chemicals Derived from Ethylene

| Primary Products<br>Secondary (Derivatives of Primary Products)<br>Tertiary (Derivatives of Secondary Products)<br>Derivatives of Tertiary Products<br>Other Derivatives | Uses |
|---|---|
| Ethylene Oxide | |
| Ethylene Glycol | Antifreeze formulations |
| Ethylene glycol dinitrate | Explosives in low freeze nitroglycerine |
| Glyoxal | Dimensional stabilizer for rayon |
| 1,4-Dioxan | Solvent |
| Di- and hexa-chlorodioxane | Chemical intermediates |
| Dioxalan | Solvent for cellulose esters |
| 2-Methyldioxalan | Solvent for cellulose esters |
| Acetate and phthalate esters | Plasticizers, solvents |
| Copolymer with terephthalic acid ("Dacron" by DuPont) | Synthetic fiber |
| Condensate with polymeric fatty acid ("Norepol") | Synthetic elastomer |
| Mono- and di-ethers ("Cellosolves" by Carbide and Carbon, e.g., Butyl "Cellosolve," Diethyl "Cellosolve") | Solvents, e.g., paints trade |
| Fatty Acid esters of monoethers ("Cellosolve" acetates by Carbide and Carbon) | Solvent—plasticizers |
| Diethylene glycol | Solvent—plasticizers |
| Mono- and di-ethers ("Carbitols" by Carbide and Carbon, e.g., Methyl "Carbitol" Dibutyl "Carbitol") | Solvents, e.g., paints trade |
| Fatty acid esters of monoethers ("Carbitol" Acetates by Carbide and Carbon) | Solvent—plasticizers |
| Fatty acid esters | |
| a) diethylene glycol diacetate | Solvent |
| b) diethylene glycol monolaurate or monostearate | Emulsifiers |
| Triethylene glycol | Solvent—plasticizers, hydraulic brake fluid component |
| Mono- and di-ethers (Ethoxytriglycol) | Solvent |
| Fatty acid esters of monethers (methoxytriglycol acetate) | Solvent |
| Mono- or di-acid esters (triethylene glycol di-1-ethylhexoate) | Plasticizer |
| Tetraethylene glycol | Solvent—plasticizer |
| Mono- and di-ethers (Dimethoxytetraglycol) | Solvent |
| Polyethylene glycol ("Polyethylene Glycol" series (liquid) by Carbide and Carbon, "Carbowax" series (solids) by Carbide and Carbon, "Ucon" and "Prestone" series (liquid) by Carbide and Carbon) | Plasticizers, dispersants, lubricants, binders |
| Monoethers (from alcohols, phenols and mercaptans) (Methoxypolyethylene glycol series by Carbide and Carbon) | Intermediates for detergents |
| "Brij" products by Atlas Powder (laurylalcohol) | Emulsifiers |
| "Cerfax 1300" by E. F. Houghton (alcohol) | Detergent, wetting agent |
| "Antara 400" series by Gen'l. Aniline & Film (alkylphenol) | Emulsifiers |
| "Antarox A" series by Gen'l. Aniline & Film (oleyl alcohol) | Emulsifiers, detergents, wetting agent |
| "Antarox D-100" series by Gen'l. Aniline & Film (oleyl alcohol) | Emulsifiers |
| "Glim" by R. T. Babbitt (phenol) | Detergent |
| "Nonic 218" by Sharples Chem. (mercaptan) | Detergent, wetting agent |
| "Sterox" series by Monsanto Chem Co. | Detergents |
| Fatty acid esters of monoethers ("Emulfor AG. ELA" by Gen'l. Dyestuff, Inc.; "Tween" series by Atlas Powder Co.) | Detergents, emulsifiers and dispersants |
| Mono- and di-acid esters (polyethylene glycol di-1-ethylhexoate) | Low-temperature plasticizer |
| "Nonisol" series by Abrose Chemical Co. (lauryl, oleic and stearic acids) | Emulsifiers |
| "Nopalcol" series by Nopco Chem. Co. (fatty acids) | Emulsifiers |
| "Advawets" by Advance Solvents | Emulsifiers |
| "Antarox B" series by Gen'l. Aniline & Film (oleic and ricinoleic acids) | Emulsifiers |
| "Energetic" by Armour & Co. | Detergent, wetting agent |
| "Myrj" by Atlas Powder (stearic acid) | Emulsifier |
| "Peg-42" by Blyco Products (stearic acid) | Emulsifier |
| "Renex 18, 28" by Atlas Powder (mixed fatty and tall acids) | Detergent, wetting agent |
| Alkylodamines | Solvent, gas scrubber to remove acidic constituents |
| Monoethanolamine | |
| 2-Nitraminoethyl nitrate | Explosive |
| Mercaptothiazoline | Accelerator for rubber vulcanization |
| Ethylene imine | Polymers in paper coatings and textile treatment |
| Fatty acid amides (derived mainly from cocoanut oil) | Detergents |
| Sodium salts of fatty acid amides | Detergents |
| Salts of alkyl aryl sulfonates | Detergents |
| Diethanolamine | Gas scrubber to remove acidic constituents |
| Fatty acid amides ("Ninol" series by Ninol Laboratories) | Detergents, textile lubricants |
| ("Amine ES" by Carbide and Carbon—stearic acid) | Emulsifier |
| Morpholine | Solvent, corrosion inhibitor |
| Morpholinoethyl alcohol | Intermediate for pharmaceuticals and rubber chemicals |
| Dioctadecylethanolamine | Detergent intermediate |
| Triethanolamine | Corrosion Inhibitor |
| Tetraethanolammonium hydroxide | Strong base |
| Triethanolamine alkyl sulfate ("Drene" by Proctor and Gamble) | Shampoo |
| "Dupanol WAT" by du Pont | Detergent |
| "Emcol 4150, 5100" by Emulsol Corp. | Detergent |
| Fatty Acid amides | Emulsifiers in waxes |
| Salts of 2,4-dichlorophenoxyacetic acid | Weed killer |
| Ethylene Cyanhydrin | Intermediate |
| Acrylonitrile | Intermediate |
| Polymers ("Orlon" by du Pont) | Synthetic fiber |
| Copolymers with: | |
| Butadiene | |
| ("Hycar" by B. F. Goodrich | Buna N synthetic rubber |
| "Paracril" by U. S. Rubber | Buna N synthetic rubber |
| "Chemigum" by Goodyear Tire and Rubber | Buna N synthetic rubber |
| "Butaprene" by Firestone Tire & Rubber) | Buna N synthetic rubber |
| Vinyl Chloride ("Dynel" by Carbide and Carbon) | Synthetic fiber |
| Vinyl Acetate ("Acrilan" by Chemstrand) | Synthetic fiber |
| Vinylidene Chloride ("Saran F-120" by Dow Chemical) | Plastic |
| 2-Chlorobutadiene ("Neuprene ILS") | Synthetic rubber |
| Acrylic acid | Chemical intermediate |
| Alkyl Acrylates | |
| Polymers | Oil additives, adhesives |
| ("Lucite" by du Pont | |
| "Plexiglas" by Rohm and Haas) | Plastics |

## TABLE 1—Chemicals Derived from Ethylene (Continued)

Primary Products
Secondary (Derivatives of Primary Products)
Tertiary (Derivatives of Secondary Products)
Derivatives of Tertiary Products
Other Derivatives

| | Uses |
|---|---|
| **Ethylene Oxide (continued):** | |
| Monothioethylene glycol | Intermediate |
| Methionine | Growth accessory substance |
| Thiodiglycol (di-2-hydroxethyl sulfide): | |
| "Kromfax" solvent by Carbide and Carbon | Solvent in printing process |
| "Mustard Gas" (di-2-chloroethyl sulfide): | |
| Tri-2-chloroethyl phosphate | Plasticizer |
| ("Flexol" Plasticizer 3 CF by Carbide and Carbon): | Solvents |
| Dioxalane (also from ethylene glycol): | Treatment of textile fibers, chemical intermediate |
| Ethylene sulfide | Solvent |
| **Ethyl Alcohol** | |
| Butadiene | Synthetic rubber |
| Polymer ("PB" or "Polybutadiene" by Phillips Pet. Co.) | |
| Co-Polymer with: | GR-S type synthetic rubber |
| Styrene | Buna N type synthetic rubber |
| Acrylonitrile | Intermediate for nylon mfg. |
| Adiponitrile (1,4 dicyanobutane): | Selective solvents |
| Butadiene sulfones ("Sulfolanes" by Shell Devel. Co.) | Solvent, anesthetic, chemical intermediate |
| Diethyl ether | Chemical intermediates |
| Ethyl amines (mono-, di- and tri-) | Refrigerant, anesthetic |
| Ethyl chloride | Plastic, protective coatings |
| Ethyl cellulose | Anti-knock compound |
| Tetraethyl lead | Chemical intermediate, solvent, protective coating intermediate |
| Acetaldehyde | |
| Crotonaldehyde | |
| n-Butyl Alcohol | |
| Butyraldehyde | |
| 2-Ethyl hexanol | |
| Acetic acid or anhydride | Rayon, plastics, chemical intermediate |
| Ethyl acetate | Solvent |
| Chloral (Trichloro-acetaldehyde): | Insecticide |
| D.D.T. (p,p'-dichlorophenyl trichloroethane) | Solvents, chemical intermediates, etc. |
| Numerous esters with acids | |
| **Ethyl Benzene** | |
| Styrene | |
| Polymers ("Lustron" by Monsanto Chem. Co., "Styron" by Dow Chemical) | Plastics |
| Copolymer with: | |
| p-Divinylbenzene "Amberlite," "Ionac," "Dowex" | Ion-exchange resin |
| Drying oils | Styrenated oils |
| Butadiene | GR-S synthetic rubber, plastics |
| Isobutylene ("S-Polymer" by Enjay Co.) | Plastic films and coatings |
| **Polyethylene ("Polythene")** | Plastic for electric wire insulation, film, paper coating |
| **Ethylene Dichloride** | |
| Ethylene diamine | Solvent and chemical intermediate |
| Diethylene triamine | Chemical intermediate |
| Triethylene tetramine | Chemical intermediate |
| Succindinitrile | |
| Copolymer with | |
| sodium polysulfides ("Thiokol") | Synthetic elastomers |
| Perchloroethylene (tetrachloroethylene) | Solvent, chemical intermediate |
| Hexachloroethane | Plasticizer |
| Trichloroethylene | Dry-cleaning solvent, degreaser |
| Hexachlorobutadiene | Transformer oil additive |
| 1,1,2-Trichloroethane | Solvent |
| 1,1,1,2-Tetrachloroethane | Solvent |
| Trichloroethylene | (see above) |
| Pentachloroethane | Solvent |
| Perchloroethylene | (see above) |
| Vinylidine Chloride | Solvent |
| 1,1,1-trichloroethane | |
| Polymers | Plastics |
| Polyvinylidene chloride | |
| Copolymers with vinyl chloride | |
| ("Saran" by Dow Chem. Co.) | |
| ("Velon" by Firestone Plastics Co.) | Plastics |
| Vinyl chloride | Solvent |
| 1,1,2-trichloroethane | |
| Polymer "Geon" by B. F. Goodrich Chem. Co. | |
| "Marvinol" by U. S. Rubber Co. | |
| "Tygon" by U. S. Stoneware Co. | Resins and Plastics |
| "Vinylite" by Bakelite Corp. | |
| Copolymer with: | |
| Vinyl acetate | Plastic |
| "Vinylite" series V resin by Bakelite Corp. | Synthetic fiber |
| "Vinyon" by Bakelite Corp. | |
| Acrylonitrile | Synthetic fiber |
| "Vinyon N" by Bakelite Corp. | Plastic |
| "Saran" by Dow Chem. Co. | |
| **Methyl ethyl benzene** | Replacement for styrene |
| Vinyl toluene | GR-S type synthetic rubber |
| Copolymer with: | |
| **Propionaldehyde** | Chemical intermediate for rubber chemicals, resins, etc. |
| Propionic acid and anhydride | Chemical intermediate solvent-plasticizer in resins |
| Pentaglycerol | Component of anti-knock fluid, solvent, chemical intermediate |
| **Ethylene dibromide** | Chemical intermediate |
| 1,2-Dinitroethane | Components of Aviation gas |
| 2,3-Dimethylbutane: | |
| 2,2-Dimethylbutane: | Components of Aviation gas |
| 3-Methyl pentane: | Poison gas |
| Ethyl cyclohexane: | Dry-cleaning solvent, degreaser |
| Di-2-chloroethyl sulfide ("Mustard gas") | Solvent, chemical intermediate |
| Trichloroethylene | |
| Perchloroethylene (tetrachloroethylene) | |

**Table 2—Ethylene Glycol Production**[1]

| Year | Million Pounds |
|---|---|
| 1941 | 151.5 |
| 1942 | |
| 1943 | 186.8 |
| 1944 | 202.4 |
| 1945 | 205.1 |
| 1946 | 192.1 |
| 1947 | 226.7 |
| 1948 | 366.7 |
| 1949 | 439.7 |
| 1950 | 510.5 |

**Table 3—End-Use Distribution of Ethylene Glycol—1950**

| Product | Million Pounds | Per Cent |
|---|---|---|
| Automotive antifreeze | 373 | 73.1 |
| Synthetic fibers | 5 | .1 |
| Cellophane, paper, leather | 22 | 4.3 |
| Explosives | 29 | 5.7 |
| Hydraulic fluids and industrial coolants | 14 | 2.7 |
| Polyglycols and glycol ethers | 16 | 3.1 |
| Alkyd resins | 6 | 1.2 |
| Adhesives and glyoxal | 3 | .6 |
| Miscellaneous | 27 | 5.3 |
| Export | 20 | 3.9 |
| TOTAL | 510.5 | 100.0 |

completely ignored herein and a continued high standard of living is assumed.

The expansion of this phase of the industry, (i.e. the production and use of ethylene-derived chemicals) can be estimated or predicted only by a critical look at the end use of its products as commodities. Consideration should also be given to the probable future volume of these commodities.

Ethylene, the starting material for many chemical products, is derived essentially from the pyrolytic cracking of refinery or petroleum field gases; this supply of ethylene may be augmented from refinery gas sources by the separation of the ethylene normally present in the refinery gas—the result of the many operations in the modern refinery. Thermo cracking of gas oil is sometimes used as a means of producing it. Ethylene in turn is converted into its many derivatives by one of several processes:

(a) Direct oxidation
(b) Reaction with halogen
(c) Reaction with acids
(d) Catalytic reaction with aromatics
(e) Catalytic polymerization

As shown in Table 1, the "commercial ethylene tree" comprises many important products, some of which are only a bridge to the end commodity. The most important of these materials are:

Ethylene Oxide and principal derivatives
Ethyl Alcohol
Ethyl Benzene
Ethyl Chloride
Ethylene Dichloride
Ethylene Dibromide
Polyethylene

It is this group that may be considered the major ethylene-derived chemicals today.

## ETHYLENE OXIDE

We are justified in turning our attention first to ethylene oxide, inasmuch as it is an important chemical building block of the future. Ethylene oxide is produced either by direct oxidation of ethylene in presence of catalyst or through the well known chlorohydrin route. Approximately one pound of ethylene is required for the production of one pound of oxide in industrial operations. Therefore, one may easily think in terms of either ethylene or ethylene oxide in considering this component part of the field.

Ethylene oxide, as such, is used as a fumigant and as a sterilizer for starch products and water soluble gums used in foodstuffs. However, these uses are small and relatively insignificant in terms of consumption.

The essential chemicals made from ethylene oxide are shown in the table below and an estimate is given of the pounds of end product produced in commercial operation per pound of ethylene oxide used.

**CHEMICALS FROM ETHYLENE OXIDE**

| Chemical | Lbs. of Chemical from 1 Lb. of Ethylene Oxide |
|---|---|
| 1. Ethylene Glycol | 1.22 |
| 2. Acrylonitrile | 1.62 |
| 3. Alkylolamines | 1.20 (Ave.) |
| 4. Polyglycols | 1.2 |
| 5. Glycol Ethers | 1.5 to 2.2 |
| 6. Non Ionic Detergents | 5.7 Approx. |

### Ethylene Glycol

In the above group, ethylene glycol today places the heaviest demand on ethylene oxide. Ethylene glycol production by all processes, as reported by U. S. Tariff Commission,[1] shows an increase from 151.5 million pounds in 1941 to 510.5 million in 1950. Annual production data are given in Table 2. Mention must be made of the fact that while most of production of ethylene glycol is from ethylene oxide, some has been made from formaldehyde and carbon dioxide by the glycolic acid process. For both 1949 and 1950, production from this latter process is estimated at 100 million pounds per year. It is anticipated that the production figure for ethylene glycol for 1951 will reach about 632 million pounds and for 1952 about 740 million pounds. These figures are based on present plants which are now being expanded and on new plant construction.

In order to arrive at the probable future of ethylene glycol, a study of the end uses today and the probable end uses in the future and their magnitude is desirable. An estimated end use distribution of the 510.5 million pounds of this product produced in 1950 is shown in Table 3.

The future major consumption of ethylene glycol will undoubtedly be as automotive antifreeze. One of the prominent new synthetic fibers in the textile industry will call for amounts comparable with some of the other leading secondary but not minor uses.

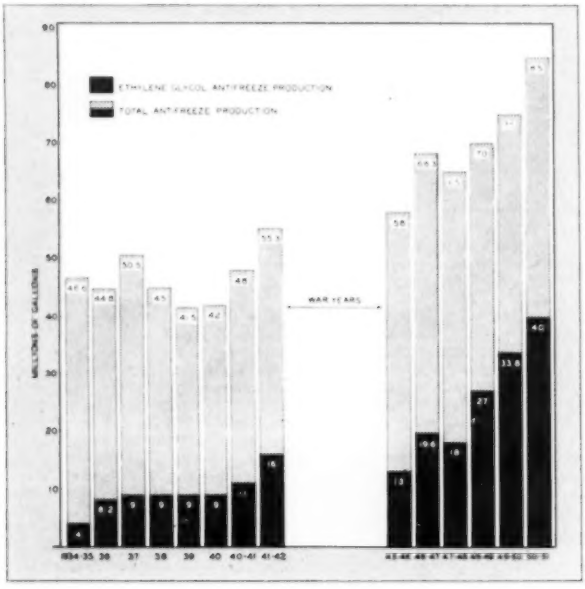
Once previously, one of the authors made a study of antifreeze consumption and this information is brought up to date in Fig. 4.

With increased availability of glycol-type antifreeze, it is possible that the per cent of permanent type antifreeze will ultimately supply somewhere around 55% of the total antifreeze market. One is always in a precarious position endeavoring to look ten years into the future. However, with the full realization that expansion must be based on such guesses, which we politely call "intelligent estimates", an examination is now made of certain facts. The 1950 passenger car and truck census was approximately 43,500,000 total.[2] This is an increase of a million over 1949. The immediate post-war years showed greater increases and we are all aware of the reasons. It is probable that the actual rate of increase will be less in the ensuing decade than it has been in the past several years because of limitation of our highways. Except for irregularities during and immediately following World War II, our total vehicle registration parallels our population curve reasonably well. Thus, by accepting the government population forecast and adjusting downward slightly the probable future vehicle registration due to highway limitation, one can estimate the future antifreeze market. Using this census-vehicle yardstick, a total antifreeze market of 100 million gallons appears reasonable in 1962, of which 55 million gallons would be of the ethylene glycol type.

### Secondary Uses of Ethylene Glycol

The largest industrial use today of ethylene glycol is in the manufacture of ethylene glycol dinitrate, an explosive. Its lower freezing point is a property of sufficient importance to warrant its continued use in dynamite and in the manufacture of other explosives. This demand for ethylene glycol appears to be fairly stable and well established.

The use of ethylene glycol in chemical manufacture, where humectant properties and low freezing points are of prime importance, should see a moderate increase. Its softening effect on fibers and films is resulting in its use where glycerine was once



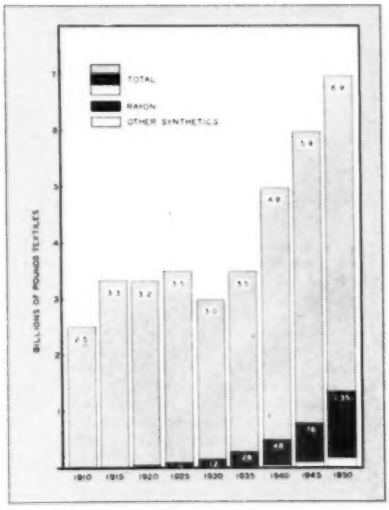




**Fig. 4** (left) — Antifreeze consumption by years

**Fig. 5** (above) — Synthetic and natural fiber production [20-24]

employed. This shift has been prompted by glycerine shortages and price advances in glycerine rather than the superior properties of ethylene glycol. It is believed that the demand will increase even in face of an expanding glycerine production.

Ethylene glycol is used in the production of glyoxal, which is finding use for shrink-proofing viscose rayon fabrics.

Ethylene glycol admixed with other materials is finding increased uses as an industrial coolant, especially in closed systems, and also as a hydraulic fluid.

One outlet for ethylene glycol that needs study, because it is a new use, is in a new synthetic fiber which is an ethylene glycol-terephthalic acid ester. This product, known at one time as Fiber V (and several other names) and subsequently as Dacron, has reached the market in small quantities and is receiving excellent acceptance.

### Synthetic Fibers

Because ethylene-derived chemicals are used in several synthetic fibers, a close look at this picture is justified. Actually, the eyes of many are focused on the expanding synthetic fiber business. Most look with almost uncontrolled optimism to the future. This holds for the manufacturers of raw materials, the manufacturers of intermediate chemicals, the manufacturers of the fiber, the textile processors of the fiber, the retailer, "the man in the street" and the financiers who must properly allocate the funds for expansion and accomplishing the end result.

The only real apprehension comes from those who support and depend on the natural fibers. The question usually is, "Where will the synthetic fiber production finally settle?" and "What per cent of the market can each expect?" The picture is very complicated. The synthetic fiber field has increased at a very significant rate. Many new and truly outstanding fibers are being offered to the American public today, although some of them are in very limited amounts. When one considers consumer spending over the past 15 years, and realizes that consumer spending for clothing and accessories is second only to food, averaging around 11 to 13% of total consumer spending and averaging about 9 to 10% of our national income, one can readily see the importance of this field and realize the reasons for the close scrutiny and study.

Total textile production for every 5th year since 1910 is shown in Fig. 5, coupled with the best estimate of the portion now occupied by the synthetics. The latter is broken down further in rayon and "other synthetics." The increase in the proportion of synthetics in the textile market is evident in Fig. 5.

The rate of increase in synthetics to date is clear, but how can a growth curve logically and intelligently be predicted? It probably can't, but on the basis of the best estimates that can be made today one can translate the probable volume for these synthetic fibers in the future into raw material requirements for them.

A look at the chemical raw materials requirements of the new synthetic fibers points to the vital importance of ethylene derived chemicals TODAY.

**ETHYLENE-BASED SYNTHETIC FIBERS**

| Fiber | Components Required |
|---|---|
| Dacron | Ethylene glycol, approx. 30%<br>Terephthalic acid, approx. 70% |
| Orlon | Acrylonitrile, essentially 100% |
| Acrilan | Acrylonitrile, approx. 85%<br>Vinyl acetate, approx. 15% |
| Dynel | Acrylonitrile, approx. 40%<br>Vinyl chloride, approx. 60% |

With our look at the ethylene glycol potential, it becomes evident that one must consider Dacron. The future of this fiber is important because of its properties. It has excellent resistance to weathering, to rot, to mildew, to moths and to chemical attack. It is wrinkle resistant, which, coupled with other properties, certainly should insure tremendous public acceptance and thus a good future. On the basis of information compiled from various sources, it appears that the capacity, present and projected, for various synthetic fibers may result in an estimated 1953 production as follows:

**SYNTHETIC FIBERS**
**ESTIMATED CAPACITY IN 1953**

| Fiber | Million Pounds |
|---|---|
| Orlon | 40 |
| Dacron | 55 |
| Acrilan | 50 |
| Dynel | 30 |
| Nylon | 150 |
| Rayon | 1600 |
| Misc. | 115 |
| TOTAL | 2,000 |

To estimate the ethylene glycol demand for the next decade requires a projection of the synthetic fiber industry. It seems logical to expect Dacron and other synthetic fibers to follow the normal growth curve such

as was experienced after the introduction of rayon. This has been done and, on this basis, 38.1 million pounds of ethylene glycol* would be required for a 123 million pound production of Dacron in 1962. This is not as large a demand for ethylene glycol as some have predicted.

Piling up the individual blocks of information enables one to summarize the ethylene glycol demand that one might expect at the end of the next decade, i.e., 1962. This summary is given in Table 4, in which the 1950 distribution by end use is repeated for comparison.

Thus the 1962 demand will require approximately 653 million pounds of ethylene oxide (or ethylene) assuming all is made from ethylene oxide.

### Acrylonitrile

The growth of the acrylonitrile market was relatively slow until last year and now appears to be due for a very rapid increase, but possibly temporary in so far as ethylene oxide is concerned. This is due to the fact that ethylene oxide is likely to be displaced in part by acetylene as the starting material for the manufacture of acrylonitrile.

The major end use of acrylonitrile has been in nitrile rubber (GR-A) and in plastics. Both uses should be relegated to second place by the potential demand for the new synthetic fibers utilizing acrylonitrile as a raw material.

The production of nitrile rubber has varied from a peak production in 1944 to a post war low of about one third of the peak, according to the data in Table 5.

To assume a normal growth curve for GR-A is very dangerous because no curve is normal if political factors are among the major influencing effects. Nevertheless, one can look at the possible situation for the future and try to evaluate the demand the raw material avails and consider the probable utilization of available capacity and couple this with possible expansion. The recent increased demand is probably a reflection of the new uses of nitrile rubber. Heretofore, the chief use of this type of rubber was in products which must be resistant to gasoline and oil such as tanks that require linings or in actual transfer lines. This use should continue.

The new uses of this rubber have been in resins and plastics and these end uses will undoubtedly increase and will probably be responsible for the further increase in consumption. Nitrile rubber is being used with phenolic resins for molded articles and with vinyl resins for sheets. Significant increases in quantities of this type of molding and sheet have been promised for 1951 and 1952. There will be competition, however, for the acrylonitrile supply from synthetic fiber demands.

From the standpoint of plants, it has been stated that with re-activation about 22,000 long tons of total capacity can be made available in the next several years for nitrile-type rubber. Assuming reactivation of plants and a nominal increased demand and, thus, some further plant expansion to follow, a figure of 30,000 long tons of GR-A does not seem to be out of line for our purposes of estimation. This in turn would require approximately 22 million pounds of acrylonitrile.

### Acrylic Synthetic Fibers

The fast growing synthetic fiber industry has been discussed previously and it was noted that acrylonitrile was a major component of several of these materials.

All of the acrylic synthetic fibers have almost complete resistance to mildew, moths, fungus, and acids, and are stable to sunlight. Their low absorbency is usually considered an advantage although in some uses it is desirable to provide for moisture absorption. Orlon filament is being made in considerable quantities and Orlon staple will soon be available in quantity. This latter fact seems to confirm the opinion that although these fibers, in some instances, will be used individually because of their respective properties, their major future outlet may well be in staple form and incorporated with other fibers both natural and synthetic. The recent move of the military to incorporate certain percentages of synthetic fibers in clothing is concrete evidence of this trend. There is little doubt of the acceptance of these new fibers. On the basis of our premise of a normal growth curve similar to rayon, after the fabric had been established, the probable growth of these fibers has been estimated for the next decade in Table 6.

A study of the trend in the plastic field as related to this raw material results in an estimate of a requirement of 60 million pounds a year in the next decade. In the miscellaneous use field the current 3 million pound requirement could well increase ten fold in the next ten years and still be a small factor. The total demand on this analysis would be 383 million pounds of acrylonitrile in 1962.

### Acetylene

Before this 383 million pound demand for acrylonitrile is translated to ethylene oxide one must try to evaluate the status of the developments in acetylene production. There is no question in the minds of many that the major production of acrylonitrile sometime in the future will be from acetylene. The real question is how soon can acetylene be produced by any one of several new methods at an economic and attractive rate. It is probable that the first significant commercial production of acetylene by one of the new methods will occur in the next five years and

**Table 4—Projected Ethylene Glycol Demands—1962**

| Product | Million Pounds | Per Cent |
|---|---|---|
| Automotive antifreeze | 506 | 63.6 |
| Synthetic fibers | 38 | 4.8 |
| Cellophane, paper, leather | 32 | 4.0 |
| Explosives | 32 | 4.0 |
| Hydraulic fluids and industrial coolants | 19 | 2.4 |
| Polyglycols and glycol ethers | 25 | 3.1 |
| Alkyd resins | 9 | 1.1 |
| Adhesive and glyoxal | 6 | 0.7 |
| Miscellaneous | 100 | 12.5 |
| Export | 30 | 3.8 |
| TOTAL | 797 | 100.0 |

**Table 5—Production and Consumption of Nitrile Rubber[1]**

| | Production (long tons) | Consumption (long tons) | | |
|---|---|---|---|---|
| | | Domestic | Export | Total |
| 1941 | 2,464 | 1,688 | | 1,688 |
| 1942 | 9,734 | 8,217 | 160 | 8,377 |
| 1943 | 14,487 | 12,405 | 631 | 13,036 |
| 1944 | 16,812 | 14,112 | 557 | 14,669 |
| 1945 | 7,871 | 8,029 | 406 | 8,435 |
| 1946 | 5,738 | 5,988 | 797 | 6,785 |
| 1947 | 6,618 | 4,536 | 755 | 5,291 |
| 1948 | 7,912 | 5,771 | 885 | 6,656 |
| 1949 | 11,072 | 8,827 | 1,574 | 10,401 |
| 1950 | 12,255 | | | |

**Table 6—Projected Demand for Ethylene-Based Synthetic Fibers—1962**

| Fiber | Capacity (million lbs.) | Acrylonitrile Requirements* (million lbs.) |
|---|---|---|
| Orlon | 140 | 140 |
| Acrilan | 105 | 89.3 |
| Dynel | 105 | 42 |

* Based on: 1 lb. Orlon requiring 1.0 lb. Acrylonitrile[2]
1 lb. Acrilan requiring 0.85 lb. Acrylonitrile (est.)
1 lb. Dynel requiring 0.40 lb. Acrylonitrile[3]

*Based on .31 lb. of ethylene glycol per pound Dacron (3).

thereafter will show a healthy growth.

The problems relating to this first commercialization are many and include not only a choice of the method to be used for acetylene production, but also the development and/or selection of the separation, purification, and concentration techniques and the elimination of polymerization and adverse chemical reactions of acetylene at each stage of its production. Happel and Marsel[13] have outlined the situation well.

It is believed probable that ethylene oxide will continue to be used for acrylonitrile production but after five years any increased demands for acrylonitrile may well be met by the use of acetylene as the raw material. It is estimated that approximately 192 million pounds of the estimated requirements of 383 million pounds of acrylonitrile in 1962 will come from ethylene oxide—a seven-fold increase over today's production.

### Ethanolamines

Although the mono-, di-, and triethanolamines were introduced in the late 1920's, the demand has not been great until recent years. Today the demands far exceed the avails. One of the first major uses of the ethanolamines was in gas scrubbing, i.e., hydrogen manufacture, carbon dioxide manufacture, and hydrogen sulfide removal and recovery. Today this use accounts for 17 to 20% of the available supply of ethanolamines. Other major uses have been in textile specialties, emulsion cleaners and polishes, for solubilizing 2,4-D and in agricultural sprays. The end-use distribution for the present production of about 33 million pounds of mono-, di- and triethanolamines has been estimated as given in Table 7.

The ethanolamines and ethylene oxide itself are most promising as raw materials for detergents and a substantial growth of these detergents can be expected. The total soap industry is a large one and the entrance of synthetics into it is demonstrated in Fig. 6.

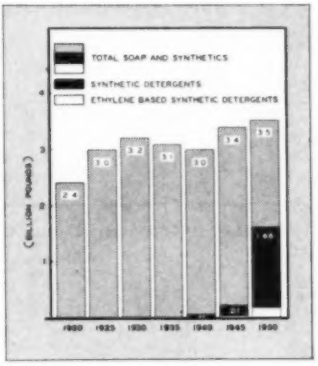



**Fig. 6**—Consumption of soap and synthetic detergents[1, 24]

The growth of the soap industry in recent years somewhat parallels the increase in population, indicating that we probably are nearly as clean as we will be, and if one can assume a similar growth trend based on the U. S. Census prediction, one can then estimate a trend for the future of soap and synthetics. Such an estimate indicates the total soap market in 1962 will reach 3,800,000,000 pounds or an increase of about 6% over the 1950 consumption.

In 1950 the total synthetics surface-active agents amounted to 664 million pounds of active ingredients and of this 60 million pounds were ethylene oxide and ethanolamine based products. The expansion of the ethylene oxide and ethanolamine based detergents has, however, been hampered by limitations in the supply of these materials.

A projection of the ethanolamine market, with the realization that the detergent field and probably the use of these materials in gas scrubbing will be responsible for the major increases, indicates a 1962 demand for 90 to 95 million pounds. This, in turn, means a corresponding increase in ethylene oxide requirements for ethanolamine production from the present consumption of 27.25 million pounds to 75 million pounds in 1962.

A similar increase in ethylene oxide for the ethylene oxide based detergents may also be expected.

### Other Uses

Other outlets for ethylene oxide include glycol ethers and polyglycols. These have been estimated to have consumed about 54 million pounds of ethylene oxide in 1950.[17] In the past this commodity has shown only a nominal growth and will probably show a similar growth in the next decade. Based on a review of their end uses, an estimated 70 million pounds of ethylene oxide will be required in 1962 for glycol ethers and polyglycols.

### Summary, Ethylene Oxide Derivatives

The demand for ethylene oxide as of today can be compiled and the estimated demand for ethylene oxide at the end of the next decade can be made on the basis of projections of the end uses of the important commodities. It is summarized in Table 8.

## ETHYL ALCOHOL

Ethyl alcohol is one of the ten top-volume organic chemicals and, along with ethylene oxide, it is one of the largest volume chemicals utilizing ethylene as a raw material. Ethyl alcohol is used as a solvent and as antifreeze, and also as a chemical raw material to such an extent that a host of other chemicals are affected by its price and availability.

Ethyl alcohol producing processes are based on the raw materials from which the alcohol is made. They fall into four categories:

(a) cellulosic materials, including waste sulfite liquors

(b) starchy materials, such as potatoes and grain

(c) materials containing sugar, such as sugar beets and molasses

(d) hydrocarbon gases.

Until the recent war years, grains and molasses were the primary raw material sources. Availability and price of these products—as well as the ease of their conversion to alcohol in relatively simple equipment—were responsible for their selection. During the war, however, raw materials of all kinds were hard to obtain, yet the need for expanded ethyl alcohol facilities was urgent. It was

**Table 7—End-Use Distribution of Ethanolamines—1950**

| Usage | TEA | DEA (million lbs.) | MEA |
|---|---|---|---|
| Surface-active amides | | 1.5 | 1.5 |
| Ethanolamine household detergents | 5.0 | | |
| Gas scrubbing | | 1.5 | 2.0 |
| Cosmetics | 5.0 | | |
| Textile processing and cleaning | 3.5 | | 1.0 |
| Agricultural: 2, 4-D salts | 1.0 | | |
| agricultural sprays | 1.5 | 1.0 | 2.0 |
| Emulsion cleaners and polishes | 1.5 | 0.5 | 2.0 |
| Other alkylolamines | 0.5 | 1.5 | 0.5 |
| TOTAL | 18.0 | 6.0 | 9.0 |

**Table 8—Projected Ethylene Oxide Demand—1962**

| | 1950 Commodity Production (million lbs.) | 1950 Ethylene Oxide Equivalent (million lbs.) | 1962 Commodity Production (million lbs.) | 1962 Ethylene Oxide Equivalent (million lbs.) | Per Cent Increase |
|---|---|---|---|---|---|
| Ethylene Glycol (from oxide) | 410.5 | 338.0 | 797.0 | 653.0 | 193 |
| Acrylonitrile | 25.0 | 24.5 | 192.0 | 188.0 | 767 |
| Ethanolamines | 33.0 | 27.5 | 90.0 | 75.0 | 275 |
| Polyglycols and Glycol Ethers | | 54.0 | | 70.0 | 130 |
| Non-Ionic Detergents (Ethylene Oxide-Based) | | 19.0 | | 60.0 | 316 |
| Miscellaneous | | 20.0 | | 70.0 | 350 |
| TOTAL | | 482.75 | | 1,116.0 | 231 |

during this period that synthetic alcohol from ethylene received its real impetus. This method of manufacture has been growing ever since. In Table 9, the percentage of alcohol derived from various sources is given for the period 1945-1950.[1]

The major portion of synthetic alcohol is produced by absorbing ethylene in sulfuric acid to give a mixture of ethyl sulfates, which in turn is hydrolyzed to crude ethyl alcohol and dilute sulfuric acid. The alcohol is purified by distillation and the acid concentrated for reuse. In recent years a process has been developed for the direct catalytic hydration of ethylene to ethyl alcohol.

Another source of ethyl alcohol from hydrocarbon gases, which further complicates a discussion of the future of ethyl alcohol production, is the potential capacity of synthetic fuel plants such as the Carthage Hydrocol unit at Brownsville, Texas. In this plant ethyl alcohol and other oxygenated products will become by-products in the reaction of synthesis gas (carbon monoxide and hydrogen from the partial oxidation of methane or natural gas) for the formation of synthetic fuels. It has been estimated that 5-10 million gallons of ethyl alcohol will be available when this plant comes into full operation in the near future.

In itself, this 5-10 million gallons of ethyl alcohol is insufficient to cause much concern to the over-all ethyl alcohol picture, particularly now, when demands are high. It must be pointed out, however, that the ethyl alcohol produced in synthetic fuel plants is a by-product material. Its production is independent of present or future alcohol demands. When disposal becomes difficult, such a condition is often conducive to price instability. For a time, there were plans to construct more than one synthetic fuel plant of this type. The effects of an additional 20-30 million gallons of ethyl alcohol from this process on the present producing methods is difficult to forecast accurately. This is true, even though little, if any, expansion is anticipated in the production of ethyl alcohol by the fermentation processes.

Annual production of industrial ethyl alcohol and the portion supplied by the synthetic product[8,9,10] are shown in Fig. 7 and in Table 10. It will be noted that a peak was reached in 1945 when 350 million gallons* were produced. This high production level was required to help meet demands for butadiene in the synthetic rubber program. In this peak year of 1945, an additional 250 million gallons of industrial alcohol were supplied by the distilling industry and through imports. The production of industrial alcohol dropped rapidly in the post-war years to 130 million gallons in 1947. Requirements are again on the rise.

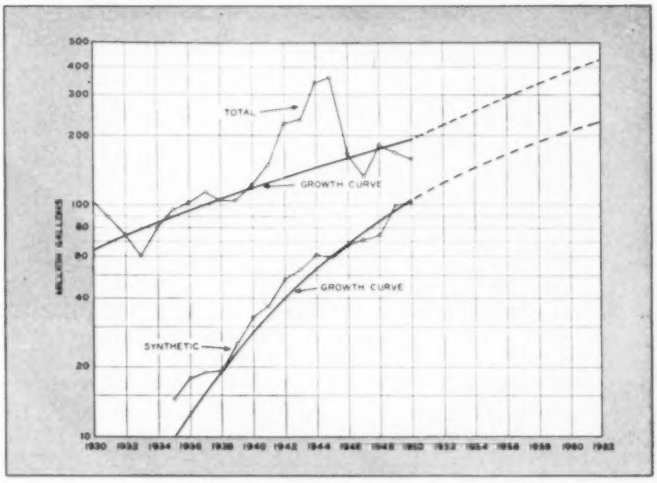



**Fig. 7**—Production of ethyl alcohol, total and synthetic[8-10]

The steady increase in the production of synthetic ethyl alcohol since 1935 is also evident from Fig. 7, and in 1950 over 100 million gallons were obtained in this manner. The consumption of ethylene in the production of ethyl alcohol is estimated at 495 million pounds in 1950 compared with 155 million pounds in 1940 and about 45 million pounds in 1935. Fig. 8 shows graphically this rapid increase in ethylene consumption.

The consumption of ethyl alcohol in antifreeze formulations shows wide yearly fluctuations, but in general, some 30 million gallons have been required each year until recently. Fluctuation in consumption are due primarily to variation in winter weather conditions. Alcohol probably finds its greatest antifreeze market in locations where winters are not severe enough to influence the average motorist toward the use of the "permanent-type" materials. The price differential between the alcohol and glycol-based antifreezes is such that this level of alcohol consumption is probably stable and may be expected to continue. The alcohol requirement

**Table 9—Raw Materials Used in Ethyl Alcohol Manufacture**

(In terms of percentage of alcohol derived)

| Raw Material | Year | | | | | |
|---|---|---|---|---|---|---|
| | 1945 | 1946 | 1947 | 1948 | 1949 | 1950 |
| Molasses | 29.2 | 26.4 | 21.7 | 42.8 | 36.3 | 31.5 |
| Grain | 43.3 | 31.8 | 16.0 | 10.4 | 3.3 | 0.7 |
| Ethylene | 17.2 | 38.6 | 53.5 | 42.1 | 46.9 | 57.5 |
| Other | 10.3 | 3.2 | 8.8 | 4.7 | 13.5 | 10.3 |

**Table 10—Ethyl Alcohol Production Total and Synthetic, and Annual Ethylene Requirements**[11]

| Year | Ethyl Alcohol Production (million gals.) | | | | Ethylene Requirements (million lbs.) |
|---|---|---|---|---|---|
| | Total | Synthetic | | | |
| | | Ethyl Sulfate | Other | Total | |
| 1935 | 95 | 9.3 | ... | 9.3 | 45 |
| 1936 | 103 | 16.6 | ... | 16.6 | 80 |
| 1937 | 117 | 17.8 | ... | 17.8 | 86 |
| 1938 | 106 | 18.6 | ... | 18.6 | 90 |
| 1939 | 106 | 25.3 | 0.1 | 25.4 | 122 |
| 1940 | 128 | 32.2 | 0.1 | 32.3 | 155 |
| 1941 | 157 | 36.8 | 0.2 | 37.0 | 178 |
| 1942 | 22 | 47.7 | 1.0 | 48.7 | 234 |
| 1943 | 236 | 50.9 | 1.0 | 51.9 | 250 |
| 1944 | 335 | 59.9 | 1.0 | 60.9 | 293 |
| 1945 | 359 | 58.8 | 1.0 | 59.8 | 288 |
| 1946 | 173 | 67.1 | 1.0 | 68.1 | 328 |
| 1947 | 131 | 70.2 | 1.2 | 71.4 | 344 |
| 1948 | 175 | 73.8 | 0.9 | 74.7 | 360 |
| 1949 | 185 | 89.0 | 9.1 | 98.1 | 469 |
| 1950 | 165 | 89.6 | 14.3 | 103.9 | 495 |

* In this discussion the term "gallon" refers to a wine gallon. A wine gallon is one gallon of 95% (190 Proof) alcohol.

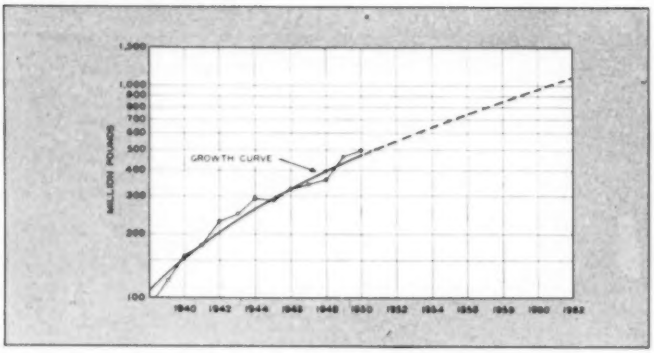



**Fig. 8**—Consumption of ethylene in ethyl alcohol manufacture[8]

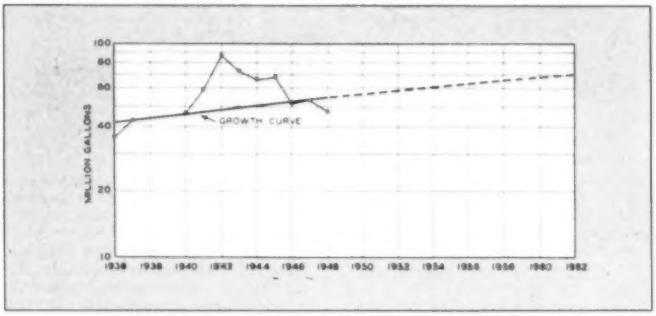



**Fig. 9**—Consumption of ethyl alcohol as a solvent[8]

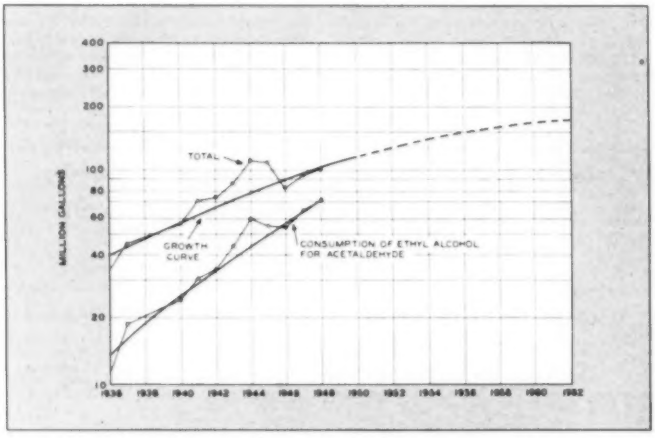



**Fig. 10**—Consumption of ethyl alcohol in chemical manufacture[8]

will likely be met by either methyl or ethyl alcohol, depending on the demand for these products for other uses and future production costs.

Ethyl alcohol is second only to water in value as a solvent and thus is employed in nearly all industries. The annual consumption of ethyl alcohol in this use is shown in Fig. 9. There has been no striking increase in consumption trends except during the war years. Over 45 million gallons were consumed in 1949, and this represents a sizable market.

Ethyl alcohol is employed in making hundreds of chemicals, including acetaldehyde, ethyl acetate, acetic acid, ethylene dibromide, ethers, and ethyl chloride. Acetaldehyde is the largest volume chemical based on ethyl alcohol and its manufacture required about 70% of the 100 million gallons of alcohol used in chemical production in 1948. Typical examples that can be cited include production of synthetic butanol and 2-ethyl-hexanol from ethylene through acetaldehyde. The total consumption of ethyl alcohol for chemicals and the amount used in acetaldehyde manufacture is shown in Fig. 10. Using the customary growth curves, it will be noted that the increased consumption of ethyl alcohol is due almost entirely to the increase in acetaldehyde manufacture.

Production of acetaldehyde by the direct oxidation of petroleum hydrocarbons poses a distinct threat to this sizable portion of the ethyl alcohol market. In fact, it has been proposed that ethyl alcohol might eventually be made by the hydrogenation of acetaldehyde. Hydrogen, however, even when made from natural gas, is still too expensive to make this possibility of immediate concern. However, the possible alternate method of manufacture of acetaldehyde must be considered in the future.

Butadiene is one of the key factors in the synthetic rubber program. During the war it was made from either ethyl alcohol, butane, butylene, or petroleum naphtha. After the war essentially all of the initial sources fell by the wayside except butane and butylene. Alcohol butadiene has not been favored because of the high cost of the alcohol-derived product.

Demands for ethyl alcohol as a solvent depend entirely on the activity of the various industries in which the product is used. Increased demands for chemicals brought about by the present emergency have again increased the volume of ethyl alcohol required. The paint and coating industries are disturbed over the present shortage of alcohol. Demands for ether and alcohol as solvents for explosives have increased substantially in recent months. These increased activities will tend to reflect the same increase noted during the period of 1941-1946 in Fig. 9. It is impossible to estimate how long these emergency demands will continue, but requirements for ethyl alcohol as a solvent will increase substantially in the next few years—probably reaching a peak similar to that observed in 1942. Without anticipating peak consumption, the gradual growth curve in the use of ethyl alcohol for solvent purposes has been extended to 1962. An estimated consumption of at least 71 million gallons annually is predicted.

Ethyl alcohol may also be expected to continue its role as a raw material

in chemical manufacture. It has been pointed out that the possibility of making acetaldehyde, the largest volume chemical now being derived from ethyl alcohol, by other methods may tend to lessen the requirements for ethyl alcohol. Should this change take place, it is probable that other chemicals now in experimental stages will require this versatile chemical. Thus, no great loss in volume will be felt. The extension to the growth trend of total consumption of ethyl alcohol for chemical manufacture in Fig. 10, allows for some cut-back in ethyl alcohol as a raw material for acetaldehyde and indicates that about 170 million gallons will be required by 1962. If, on the other hand, the bulk of the acetaldehyde manufactured were to continue to employ ethyl alcohol as a raw material, this value would be low.

The reactivation of the synthetic rubber plants has already been mentioned. An estimate has been made that these plants will require ethyl alcohol at the rate of about 180 million gallons annually by the end of 1951, in spite of the fact that the alcohol-based butadiene is not the most economical method of manufacture. The future of alcohol-based butadiene depends on two factors (a) emergency conditions in which price is no objection or (b) the production of low cost ethyl alcohol.

With an increased reliance being placed upon synthetic rubber, and in view of existing plants which can utilize ethyl alcohol for producing butadiene, it can be expected that the consumption of ethyl alcohol for this purpose may continue even after the national emergency. It is, therefore, estimated that the demands for ethyl alcohol for synthetic rubber will continue at the present predicted rate of 180 million gallons annually for several years. Whether this demand will be in effect in 1962 is difficult to predict, but it is probable that at least a portion of the requirements will exist. It is predicted that about 150 million gallons will go to butadiene manufacture in 1962.

In summary, the following estimates have been made for ethyl alcohol demands by 1962:

**PROJECTED DEMANDS FOR ETHYL ALCOHOL—1962**

| | Million Gallons |
|---|---|
| Synthetic Rubber | 150 |
| Solvent | 71 |
| Chemical Manufacture | 170 |
| Antifreeze and other | 40 |
| Total | 431 |

The source of ethyl alcohol for future demands is complicated by economics, politics, and memories of past performances. The fluctuations in price of carbohydrate raw materials, some of which are imported, work a constant hardship upon alcohol producers using these materials. Government subsidy for the production of alcohol from grain is an ever-present possibility. In spite of the increased cost in ethylene over the past few years, it appears that it is the raw material of choice in the expansion of ethyl alcohol facilities. Although producers have released very little information on the cost of making ethyl alcohol from ethylene, it is known that in pre-inflation days, appreciable quantities moved at about 20 cents per gallon. Ethyl alcohol has ranged in price from a low of $0.20 to a high of $1.145 per gallon.

In spite of the apparent demand for ethyl alcohol and the price at which it may be produced from ethylene, present and potential producers are reluctant to comment on expansion or construction of facilities.

An extension of the growth curve on the production of synthetic alcohol in Fig. 7 indicates that, by 1962, at least 230 million gallons will be produced by this process.

To produce 230 million gallons of synthetic ethyl alcohol by the present esterification and hydrolysis process would require about 1,110 million pounds of ethylene.

*(This article will be concluded in the November issue of* PETROLEUM PROCESSING—*Ed.)*

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## Meet the Authors

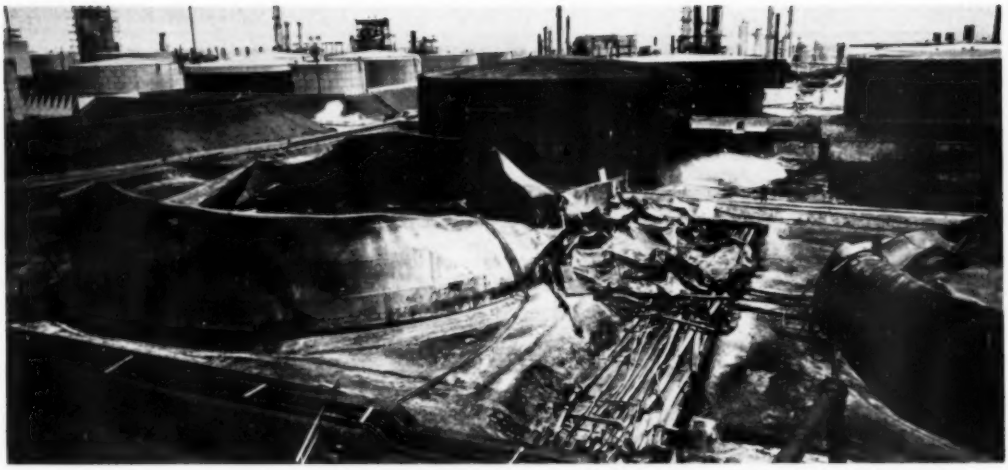
Wayne E. Kuhn

Dr. Wayne E. Kuhn, a native of Wisconsin, attended school in Oregon, graduating from Reed College, in Portland, in 1925. He secured his Ph.D. degree from Cornell University in 1929. He entered the service of The Texas Co. as chemist at Bayonne, was transferred to Port Arthur and, in 1933, was made assistant chief chemist there.

John H. Hutcheson

In 1937 he returned to New York as Assistant to Director of Research, and became successively Assistant Director of Research, Assistant Manager of the Technical and Research Division and, in 1938, Manager of that Division, which position he holds today. In 1950 he was awarded the Honor Scroll of the New York Chapter of the American Institute of Chemists, in recognition of his work along various lines in advancing the chemical profession.

John W. Hutcheson is a research chemist in the Beacon, N. Y. laboratories of The Texas Co. A native of Missouri, he secured his AB from Central College, Fayette, Mo., and his masters degree from Oklahoma A & M, Stillwater, Okla., in 1941. Shortly thereafter he joined The Texas Co. research staff at Beacon.



**Tank blending of butane** is thought to have caused this tank farm fire . . .

# Five Fire Protection Lessons Proved by Tank Farm Blaze

Studies made by Union Oil Co. engineers of the causes and results of a recent tank farm fire brought out or proved a number of important factors connected with plant fire protection practices:

1—Don't blend butane and gasoline in tanks. Use a closed circulating system.

2—Use all-steel construction for new or replacement pipe manifolds in tank blocks.

3—Back-weld all threaded steel connections to prevent their pulling free if exposed to severe thermal expansion.

4—Calculate the risks in using jack-knife type swing joints for earthquake protection. The packing may burn out.

5—Maintain API tanks properly, so that when overpressured they'll fail as designed—at their roof-shell seams without failure of shell or bottom.

Some of these are standard practice with Union; but the fire pointed up their importance. These five lessons and other facts concerning the fire are brought out in the following article, based on information obtained from James E. Hill, Union's Training & Safety Supervisor. Mr. Hill's department serves in an advisory capacity to management on fire protection engineering.

*By* ***FRANK BREESE***
***West Coast Editor***

ON JULY 12 fire broke out in the tank farm at the Wilmington, Calif., refinery of Union Oil Co. of California. Before the last flames were extinguished more than 75 hours later, product and equipment loss had reached $1,685,000.

The fire directly involved six 80,000-bbl. API steel cone-roof tanks. Three were destroyed completely; three were damaged but retained their roofs because of protection by cooling streams; one of these suffered only minor damage although partially surrounded by fire. It was also protected by water. All contained motor gasoline or blending stocks for such fuel.

## *How the Fire Started While Blending Butane*

About 2 p.m., Thursday, July 12, the roof of Tank 100 was blown off as a result of an explosion in the tank. It contained 17 ft. of 41° API blending stock (267° F. initial BP)—31,700 bbls.—with 3 in. of water bottoms.

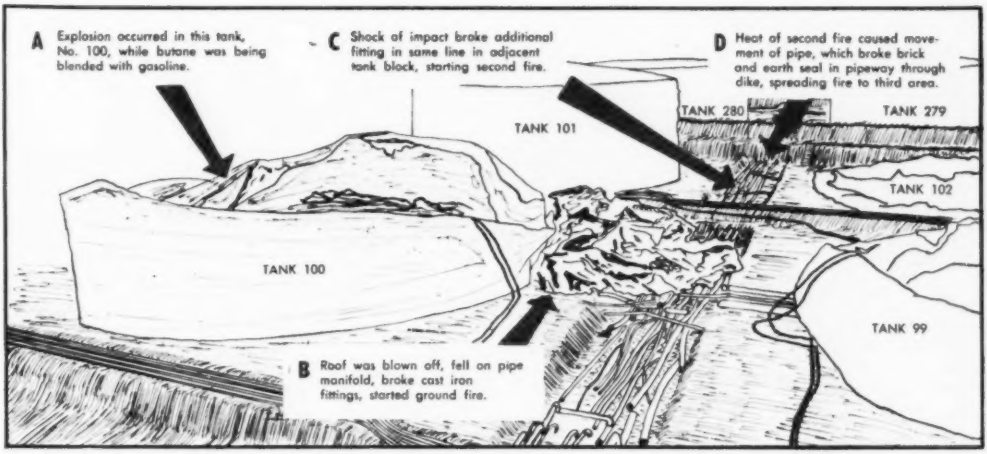
Butane was beng blended into this stock by introducing it through a 3-inch water-draw line into the bottom of the tank. A small amount of butane had been charged into the tank when the explosion occurred, resulting in the worst fire experienced in Union Oil's refinery history of over 50 years. This method of raising vapor pressure of gasoline blending stocks (by adding butane liquid to the stock in a tank) has been common in industry for many years without known fire history.

Company engineers believe static electricity caused the ignition.

Very likely in the past the base stock in the tanks normally was sufficiently light to produce an initial atmosphere over the oil too rich to ignite by static sparks, or the butane quickly enriched the vapor above the oil so that it did not ignite. In the case of Union's recent fire, it appears that the combination of a heavier stock and lower initial butane feed rate was such that when the spark occurred in a fringe zone of proper flammable mixture, a relatively small accumulation of vapor exploded. Although of light intensity, the explosion was sufficient to tear off the roof.

**LESSON 1—**

**Union Oil has discontinued the practice of blending butane in tanks. The company is now blending in a**


A Explosion occurred in this tank, No. 100, while butane was being blended with gasoline.
C Shock of impact broke additional fitting in same line in adjacent tank block, starting second fire.
D Heat of second fire caused movement of pipe, which broke brick and earth seal in pipeway through dike, spreading fire to third area.
TANK 280
TANK 279
TANK 101
TANK 102
TANK 100
TANK 99
B Roof was blown off, fell on pipe manifold, broke cast iron fittings, started ground fire.

. . . **the chronological progress** of which is shown in this perspective sketch

**closed circulating system and returning the mixture to the tank. All storage operations dealing with oils of an intermediate boiling range are being studied to establish new safety precautions for them. Such oils in storage tanks may have sufficient vapor within the flammable range directly over the oil surface to be ignitable by static charges.**

## *Tank Roof Falls, Breaks Cast Iron Pipe Fittings*

After tank No. 100 exploded, the roof fell onto a manifold in an adjacent pipe trench and broke cast iron fittings which released oil from the bottom of this tank and immediately produced a great ground fire around this and a companion tank (No. 99) within the same diked enclosure. If the roof had fallen on any of the other three sides of the tank, no ground fires would have occurred, and it is likely the tank fire could have been extinguished with foam. The magnitude of the general fire was caused by failure of the cast iron fittings in the pipeway, resulting initially from the impact of the roof and later by fire exposure.

**LESSON 2—**

**The company believes the fire justifies its policy, existent for at least 10 years, of using all-steel construction for replacements or for new pipe manifolds in tank blocks. Recommendation of wholesale replacement of older cast iron equipment in all tank blocks is regarded as economically impossible, and overall fire history does not justify it, the company believes.**

**It is known that cast iron is vulnerable to impact, shock and fire exposure. The affected manifolds were typical of the 1920-30 construction period.**

## *Impact Breaks Fittings In Adjacent Tank Block*

Shock of the impact when the roof of tank No. 100 fell is believed to have broken a cast iron fitting in a continuation of the same pipe in an adjacent tank block, releasing gasoline at that point. The seal in the pipeway through the dike separating the two tank blocks was not broken. The gasoline flowing from the broken fitting in the adjacent block ignited, and the resulting fire broke other fittings and released gasoline from another tank (No. 101) in the adjacent block within 10 to 20 minutes after the first fire.

The second fire caused warping and movement of pipe; which broke brick and tightly compacted earth seals in a pipeway through dikes between a second and third tank block. Then the fire spread to the third area, containing two gasoline and one "diesol" tank, and they were involved about 40 minutes after the first fire started.

The steel piping (1943 construction) in the third tank block withstood severe fire exposure without failure, although lines warped severely. Where steel flanges and couplings of an earlier period were not backwelded, the outside members expanded and permitted the pipe to pull free without thread distortion.

**LESSON 3—**

**Broken fittings on each side of the dike may permit oil to flow freely through the open pipes even through the seals may remain intact. Where pipes warp and move as a result of fire exposure, they may produce leaks in dike seals and make them ineffectual.**

**All threaded steel connections should be back-welded. Weld-neck flanged equipment showed less less tendency to warp than back-welded slip-on or screw connections.**

* Union's trade name for Diesel fuel.

## *Packing in Swing Joints Burns Out, Releases Fuel*

Packed flexible couplings, used in jack-knife type swing joints for earthquake protection for piping connected to the tanks, failed in the exposure fire. In all cases, the packing burned out. In two cases, the swings were not supported, and the couplings expanded and permitted the 12-inch pipe ends to separate and release fuel to the open.

The couplings at the "diesol" tanks were not directly exposed to the fire by using foam protection, and they served an excellent purpose. When the expanded all-steel pipe lines from the "diesol" tank contracted after the fire, the pipes leading to this tank manifold shifted about 30 in. laterally. The movement was taken up without undue strain on the tank connections by the jack-knife swings.

**LESSON 4—**

**Union Oil believes it is difficult to outlaw generally such type of swing joints at all storage tanks. In the determining of the calculated risk, it is necessary to balance the chance of a ground fire around a tank against the need for the conventional swing for earthquake protection.**

## *Tanks Rupture at Roof According to Design*

All tanks were of typical API construction. The roof of the tank that exploded failed completely around the roof-shell seam with the ½-in. rivets failing in tension. Three other tanks were partially surrounded by fire.

**Warping of pipeline** broke brick and earth seal in dike separating Tanks 101 and 280. Daylight can be seen through the breach at far end of trench. Failure of 12-in. pipe was due to lack of back-welding at screw collar

and the internal vapor load exceeded the venting capacity of two 8-in. and one 20-in. vents and one 6-in. gauge hatch. Their roofs also ruptured partly around the shell-roof seams according to the API basic design formula. Two had riveted and one welded seams.

There were no failures in the shells of any tanks. In the case of two tanks, after the roofs failed, the side walls sagged, leaving the vertical roof supports upright; and for a time, the roofs stood bulged upwardly as though they were under a heavy pressure load—to the concern of some uninformed observers.

Four tanks were severely exposed to radiant heat and two of these to direct flame contact for over 60 hours. Hose streams directed upon their roofs, to provide a thin sheet of water flowing down the exposed side walls, provided excellent cooling, and the paint suffered only minor damage. Tank 101 was directly exposed to severe flame impingement for over 60 hours, and 80% of its side walls and its roof did not collapse. The other side wrinkled but stood erect. It was protected by cooling streams.

For over 70 hours, gasoline Tank 279 suffered direct flame impingement from fuel draining from an open coupling at its pipe manifold. The shell warped and sagged on the exposed side; the vapor burned freely at the vents and breaks in the shell-roof seam. There were no shell failures, and the tank retained its contents until it slowly drained out. Cooling streams could not be used on this tank for risk of destroying a foam blanket in the dike area used to prevent exposure to an adjacent "diesel" tank.

**LESSONS 5—**

**Properly maintained API tanks, when overpressured due to explosion or excess vapor loads, fail at their roof-shell seams without failures of tank shell or bottom.**

**Motor fuel gasoline tanks contain an atmosphere that is too rich to burn and will suffer severe direct flame impingement without risk of explosion or shell failure. The vapor will burn quietly from roof openings.**

**A relatively small amount of water, properly directed for cooling, will protect severely exposed tanks with only paint loss.**

## *General Notes on How Crews Fought Fire*

Refinery crews had cooling streams on exposed equipment within a few minutes after the fire started. Maximum protection with minimum water demand was obtained by properly directing streams so as to provide a sheet of water down the exposed side wall. Streams directed upon the tank walls are not regarded as efficient because of limited coverage and water loss by splash-off.

The company described the housekeeping in the area as excellent and reported no serious plugging of the the catch basins with silt or debris. An average of about 10,000 gpm of water (14,000 peak load) was used for cooling streams and for foam generators. The 12-in. and 18-in. sewers handled the run-off nicely. At no time did appreciable liquid accumulate in the dike enclosures.

The 4000 gpm high pressure fire water system was augmented by transfer of salt water from the refinery cooling system, using Los Angeles City Fire Department pumpers. Supplemental water also was supplied from the harbor using one of the refinery's ship loading lines which, at the start of the fire, was standing full of water following a routine hydrostatic test.

Foam was not used in any of the tanks because the tanks were draining the oil through operating pipe lines to the diked areas around them. The least exposed tank of the six (No. 280) contained 71,000 bbls. of motor fuel, and about 80% of this was salvaged by pumping out, the remainder being lost through leaking swing couplings and gaskets in the steel pipe manifold.

A main problem was to prevent the fire from spreading to a "diesel" tank and then to an adjoining area where a natural gasoline distillation plant and casinghead tanks and propane tank stood. By the use of a foam blanket in the lower tank block, fire fighters were able to work close in on dikes using cooling streams on exposed adjacent equipment, and the fire was stopped and held at that point.

A total of 496,800 lbs. of 2-in-1 chemical foam powder was used in fighting the fire. The refinery's own foam supply of 143,750 lbs. was augmented by 293,700 lbs. borrowed from neighboring refineries and pipe line stations, plus 60,350 lbs. bought during the fire.

All facilities and oil lost were fully involved in the first 45 minutes of the fire. According to Union Oil, nothing that was lost could have been saved.

Four men were injured in the fire, none by burns. Three were injured when a fire hose got away from them, another sprained his ankle.

The fire burned severely for over 48 hours, and final embers were extinguished 75 hours after it started.

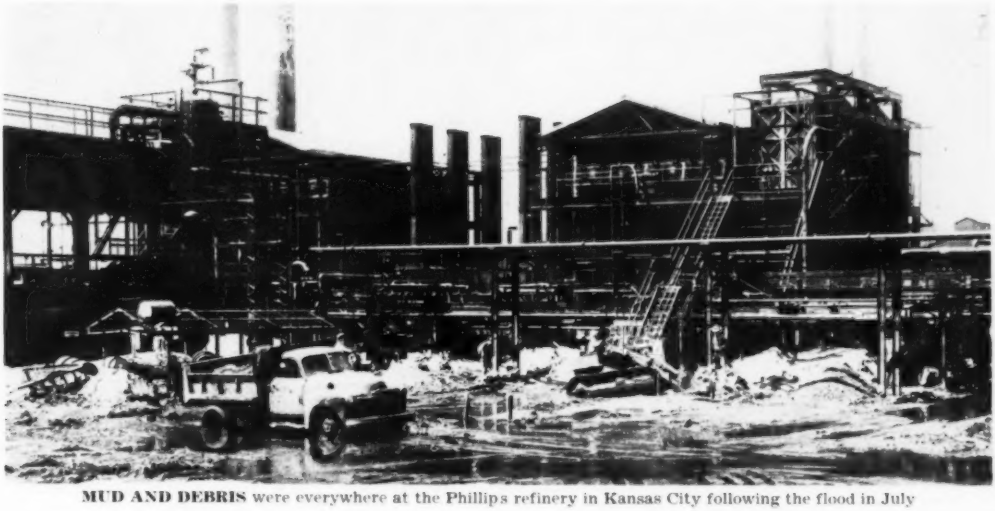
Union Oil's major fire-fighting plan, known as "Fire Headquarters Plan", received its most severe test. It was viewed as basically satisfactory, but company officials expect to "polish it up" on the basis of this experience.

Under the plan, the overall emergency operation is directed by the refinery manager, E. B. Palmer. In charge of all fire fighting is the refinery fire chief, in this case Jesse G. Marshall, supervisor of fire and safety at the refinery. Assisting refinery crews were L. A. city fire companies which deployed an average of 75 men and 11 pumpers. Navy, Coast Guard and U. S. Army Engineers also aided.

All refinery operating units were shut down under the direction of Operating Superintendents E. R. Friess, Paul Fryar and M. S. Thomson because of the need for manpower and supervision and the possible hazard to adjacent operating equipment. Utilities and water supply were handled by Mr. Fryar, operating superintendent.

Manpower and transportation of equipment were directed by Chief Engineer J. W. Towler.

Press relations and emergency food and water supplies were handled by acting personnel superintendent, Paul Doyal.



**MUD AND DEBRIS** were everywhere at the Phillips refinery in Kansas City following the flood in July

# Phillips Digs Out Flooded Refinery

WHEN the Missouri River flooded Kansas last July, the 60,000 b/d refinery of Phillips Oil Co. at Kansas City was knocked out.

The refinery went out of production at 10:53 p.m. on Friday, July 13, when the main switch was pulled and the plant plunged into darkness as flood waters rolled in.

Prior to that moment, sandbagging and other delaying tactics allowed sufficient time for an orderly shutdown of the refinery. No. 4 and No. 9 stills were shut down first, then the entire lube plant and the Fluid cat cracker—the latter unit in only eight hours.

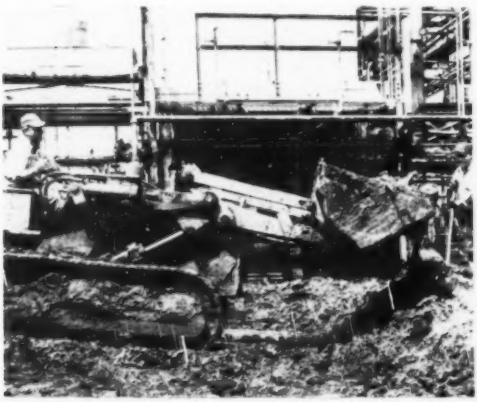
Approximately 50 motors were removed from the refinery to higher ground. All temperature recording equipment was taken out. Empty or partly filled storage tanks were filled with water to keep them from floating away. Outlet caps were removed from empty tank cars to permit water to flow inside. Refinery files and tracings and other important documents were removed, although blueprints had to be left behind. All mobile equipment was driven away.

It took a week for the flood waters to recede—and then the cleanup job started. This was the picture as workmen returned to the refinery grounds: Some 900 pieces of electrical equipment, including 850 motors ranging in size from 1 to 250 hp, various controls, motor starters, and switch gears, were soaked in water and mud. All these had to be removed, dried out and reinstalled. Many were sent outside for baking out, but some special motors were dried in place.

In an area 1,000 by 500 ft. in one corner of the refinery, the Missouri River had deposited a layer of sand 8 ft. deep which covered pipes, pumps, motors, instruments, electric switches and a control house. Most of this sand had to be dug away by hand.

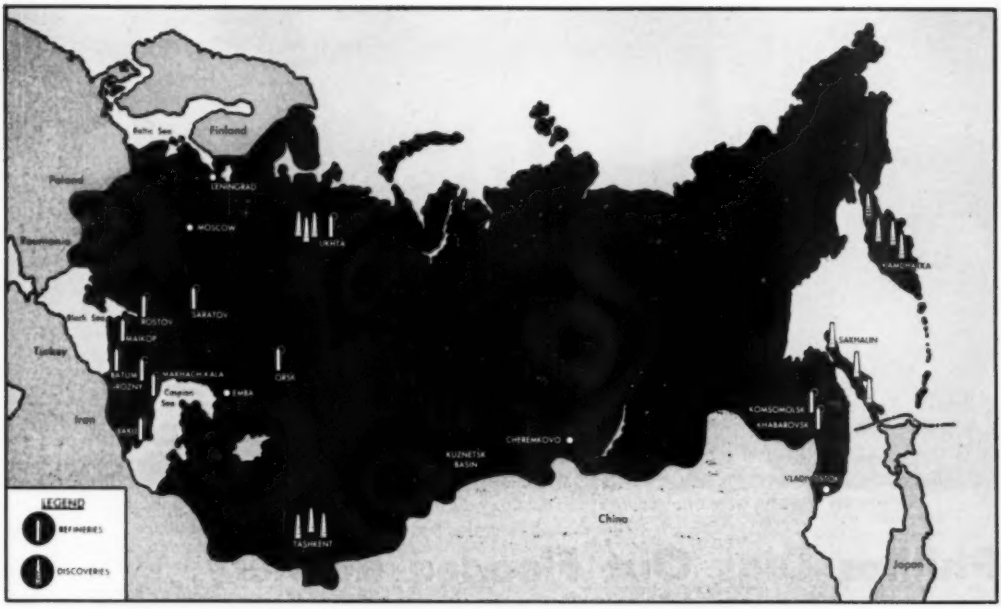
The first move toward getting the plant back on stream was to clean out the power house and generate steam. Portable generators using LP-gas were used to fire the boilers. Portable pumping units were brought in to remove as much of the muck as possible.

The refinery was back on stream just 7 weeks after the shutdown.



**TONS OF MUCK** had to be "evacuated"—some with power equipment, much by hand

**FLOOD-DAMAGED MOTORS**—850 of them—had to be removed, baked out, and put back in place




**Where Russia's oil industry is located**—her oil fields and her refineries

# Can Russia Fuel a War?

## Don't underestimate Stalin's resources. His oil output now is 4 times what Hitler's was

*By* ***MARSHALL SITTIG***

DON'T underestimate the power of the Russian petroleum industry to fuel a Soviet emergency.

Some authorities in the past year have stated in effect that Russia does not have sufficient petroleum to wage a war.

Rear Adm. M. Zacharias (ret'd.) recently said that the Russians' "greatest vulnerability is in lack of oil" and that "they are getting most of their oil right now from the Rumanian oil fields; those wouldn't last one minute if the Russians started to wage war."

In a recent magazine article, Demitri B. Shimkin, a staff member at the Russian Research Center at Harvard University, reported that "the Soviet oil and gas industry proved grossly incapable of meeting the needs of World War II," and that "today, the readiness of the Soviet oil and gas industry for a major war is not substantially greater than in 1940."

It is dangerous, however, to assume that the Russians have insufficient oil to wage a war. It has been pointed out that Hitler's Germany operated on only 75,000,000 bbls. a year, or less than a fourth of what Stalin's Russia produces today. In a totalitarian state, all available petroleum is ruthlessly diverted to the specific needs of the armed forces; there is no civilian competition for oil products.

### Crude Reserves, Production

Russia was the largest producer of crude in Europe prior to World War II, 216,866,000 bbls. in 1939 out of a total European production that year of 274,897,000 bbls. Last year, according to estimates made available by the U. S. State Department, Russia and Russian-dominated Eastern Europe produced 871,800 b/d, or about 320,000,000 bbls. total.

That production hardly compares in scope or rate of increase with ours, as illustrated in Fig. 1.

By their own estimates, the Russian's possess the largest petroleum reserves of any country in the world. In their report to the Seventeenth International Geological Congress in 1937 a total of 47,800,000,000 bbls. were reported. Of this total, 1,730,000,000 bbls were proved and prospected, and an additional 4,900,000,000 bbls. were "visible", leaving a balance of 41,170,000,000 bbls. as a mere estimate. The sum of the proved and visible reserves, 6,630,000,000 bbls., compares with 13,250,000,000 bbls. for the United States on the same basis.

The locations of the major Soviet oil fields are shown on the map at the start of this article.

Baku, the primary producing field in the Soviet Union, is a very old field, production there dating from 1869 (compared with Drake well in 1859 in this country). Baku supplied half the world's output of petroleum in 1901. Pipelines now connect Baku on the Caspian Sea with Batum on the Black Sea, expediting the flow of Baku petroleum to markets in European Russia by tanker.

A so-called "Second Baku" is now being actively developed between Emba at the north end of the Caspian Sea and Orsk at the southern end of the Ural Mountains.

The remainder of the Azerbaidzhan province, lying between the Black Sea and the Caspian Sea, centering in the Grozny and Maikop fields, constitutes the third major oil-producing area in the Soviet Union.

The above fields are essentially all in older European Russia. The accent in industrial development is to the North and the East for strategic reasons. Thus, oil has been discovered at Ukhta in the Pechora River basin in the Far North. Near Tashkent in Central Asia are some deposits. On Sakhalin Island in the Far East, there are substantial reserves. There is some petroleum on the Kamchatka Peninsula. Unfortunately for the development of the Siberian economy, however, no major oil deposits are known in the vast expanse of Soviet Siberia between the Urals and the Pacific Ocean.

### Refining Technology

Soviet refining methods fall within the technological blackout which has covered most recent Russian engineering developments. As in other fields of engineering, journals which cover scientific subjects are still more or less available for export, but those covering actual plant equipment and construction are unavailable. In general, however, the Russians possess the know-how required to build modern refineries. American organizations have built modern thermal and fixed-bed catalytic cracking plants in the Soviet Union, some of these at the urging of our government during that portion of World War II when Russia was our ally. Russian scientists have reported experimentation with fludized solids, but it is not known whether they have Fluid cracking units in operation in the U.S.S.R.

A recent (1947) Russian "Handbook on Petroleum Technology" covers laboratory and semi-works scale installations and describes thermal and catalytic (fixed-bed) cracking units, a unit for the alkylation of benzene with ethylene, units for contact filtration and for selective solvent extraction. Thus, on a small scale at least, the Soviets are able to handle modern refining techniques quite adequately.

High-temperature aromatization units for the production of benzene and toluene are in large-scale operation in the Soviet Union.

### Refinery Locations

The refinery cities in the Soviet Union have been spotted on the map. They include one in the Far East at Komsomolsk where a refinery has been built by American technologists. At Khabarovsk, also in the Far East, is a refinery including a cracking plant for the processing of Sakhalin crude.

A refinery has been reported at Ukhta in the Arctic.

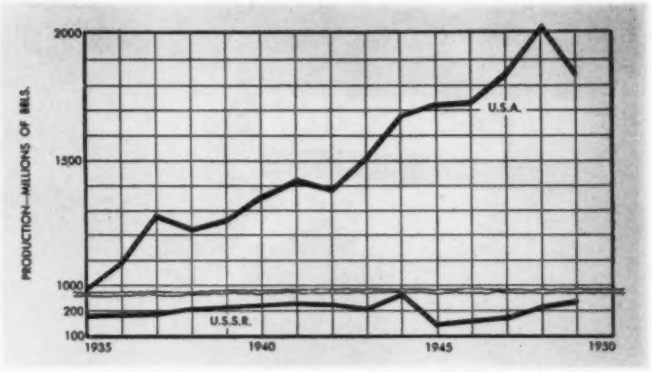



**Fig. 1—Comparison** of U. S. and U. S. S. R. petroleum production

The main refineries in European Russia, where the bulk of Red petroleum resouces are found, are located at Orsk, at Saratov, at Batum, at Baku, at Rostov-on-the-Don, at Makhach-Kala, at Grozny, and at Maikop. Of these, only the refineries at Saratov and Orsk are apart from the old Black Sea-Caspian Sea area.

Refining capacity of The U.S.S.R. as of Jan. 1, 1941, is reported to have been about 640,000 b/d. As of 1950, the U. S. State Department estimates, capacity was 880,518 b/d.

### Synthetic Fuels

Since, as outlined above, petroleum is not abundant in the vast Siberian area, synthetic fuels from wood, charcoal, coal, peat, shale, and grain are under intensive study.

In the Leningrad area and in the adjoining Estonian Republic, shale is exploited widely and a pipeline for the transport of gas from shale gasification is built or being built from Estonia to Leningrad to reduce petroleum requirements in the Leningrad industrial area.

Synthetic fuel plants for the manufacture of gasoline from coal are located at Cheremkovo in the heart of the new Siberian industrial area near the Kuznetsk Basin. German plants from the Soviet Zone of Germany have been dismantled and set up in the Soviet Union. Likewise, many German fuel technologists are now at work on the design of synthetic fuel plants to power an expanded Siberian economy. Total Soviet production of synthetic fuels from coal and shale is stated to be 900,000 tons in 1950.

A plant is under construction at Tula, just south of Moscow, for the gasification of coal. The gas will be piped to Moscow to supplement the natural gas supplied from Saratov by pipeline. Underground gasification of coal is also being utilized in the Moscow area as a source of substitute fuel for homes and factories. The total amount of gas produced by underground gasification in the Soviet Union in 1950 is estimated to be 24,800,000,000 cubic feet.

One process which resembles underground gasification in that the heat of the cracking reaction is generated in situ is the Dubrovai process for the cracking of petroleum products. This process, which is in commercial operation in the Soviet Union, charges preheated oil into a reaction chamber along with a small amount of air which further heats the charge by partial combustion. Features of the process include the absence of coke or soot formation, the presence of some CO and $CO_2$ in the cracked gases, and the presence of some oxygenated products in the cracked gasoline product. The product has a high olefinic and aromatic content.

Underground gasification of spent oil sands is a process also reported to be practiced in Russia.

### Substitute Fuels

In addition to the production of synthetic liquid and gaseous fuels in central installations, much work has been done on special automotive power plants using substitute fuels.

Wood is one such fuel. In 1940, there were 70 plants under construction for the production of wood chips for motor-car generators. It has been estimated that the actual number of woodburning automobiles and trucks in operation in the U.S.S.R. in 1942 was about 100,000.

Other automotive power plants have been developed using coal and peat as fuels.

## About the Author

Marshall Sittig is a chemical engineer located with a major automobile firm in Detroit. His outside interests include the reading of Russian journals, which he handles for Chemical Abstracts. That reading, supplemented by data from his own files, supplied the material for this article.

## REFINERY INSTRUMENTS

# *What Makes Them Tick?*

### Part 4—Temperature Measurement

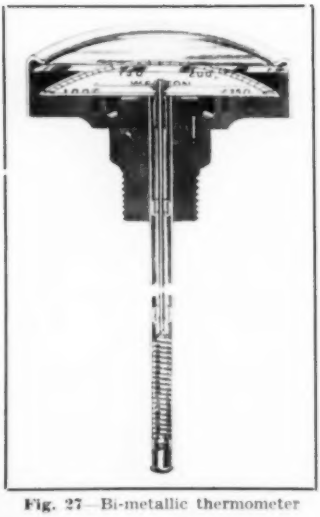


Fig. 27—Bi-metallic thermometer

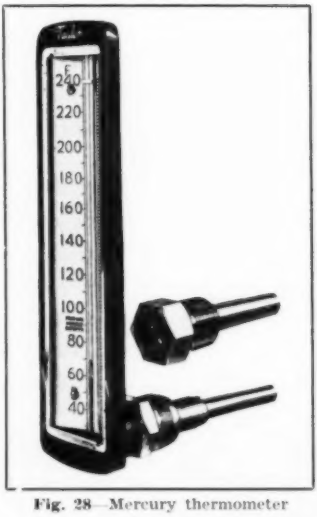



Fig. 28—Mercury thermometer

By **CORNELIUS E. SHANNAHAN**
*Instrument Engineer,*
*M. W. Kellogg Co., New York*

BESIDES being one of the most important instrument functions in a refinery, temperature measurement is also the most complex. As outlined in the introduction to this series of articles, the scope of the temperature group can be divided into two branches: the mechanical or filled system type and the pyrometric type. Radiation elements may be excluded from this discussion for the reason that the advantages they offer in industrial service rarely apply to refinery services.

There are, of course, other means of temperature measurement than those classified above; namely, the bimetallic and mercurial thermometers. The characteristics of these thermometers are too well known to require any complete description here, but in order to offer a complete picture as well as perhaps acquaint the reader with their industrial appearance, a

brief resume follows.

The bimetallic element, a sectional view of which is illustrated in Fig. 27, is wound into a continuous helix, anchored at one end and attached to a shaft at the other. In accordance with the bimetal principle; as the temperature changes, the helix will twist. This motion is translated to the shaft and thence to an indicator to read temperature on a calibrated scale.

The mercury or industrial thermometer is familiar to everyone and is distinguished in refinery service from that in the laboratory only in that in a refinery the instrument is furnished with a casing to protect it from breakage. A scale with more prominent figures is also used for readability. One point concerning the industrial thermometer should be remembered, especially where the process temperature is high and ambient temperatures are low. That is that the mercury does not expand uniformly throughout the bore of the thermometer tube, because the temperature of the mercury is lower in the upper portion of the tube as compared to that in the bulb. An approximate correction may be applied by use of the following formula:

Stem correction (in degrees) = $0.000154\ (t - t^1)N$

where: $t$ = temperature read.

$t^1$ = average temperature of the exposed column of mercury

$N$ = length, measured in degrees, of the thread exposed between the top of the heating liquid and the point $t$.

It should also be pointed out that almost all types of thermometers are installed with separable sockets to protect the element from corrosion and/or erosion due to the process materials. In fact, separable sockets, sometimes referred to as protecting wells or thermowells, are used for all temperature sensitive elements for the same reason. A typical assembly for an industrial thermometer is shown in Fig. 28.

The mechanical and pyrometric types of temperature instruments are outlined as follows:

**MECHANICAL TYPE** — There are four classes of temperature measuring devices in this category and all are most commonly referred to as the filled system type of thermometer. Basically, all operate on the theory that as the temperature to be measured increases or decreases, the material contained in the system expands or contracts and moves a helical spring (just as it does in a pressure gage). A complete assembly of a bulb, tubing, and spring is illustrated in Fig. 29.

Following is a description of each type of filled thermometer, listed in the order of their numerical classification:

**Class I**—The thermal system of this thermometer is completely filled with an expansible liquid as shown in Fig. 30. Due to the fact that it is only case compensated, the tubing length is limited to 25 ft. The reason for this is that if the case and tubing were exposed to different temperatures, the compensation which responds only to case temperature would not give an accurate correction. Therefore, the tubing limitation is needed to minimize this possible error. Range of the Class I instrument is —150 to 500° F.

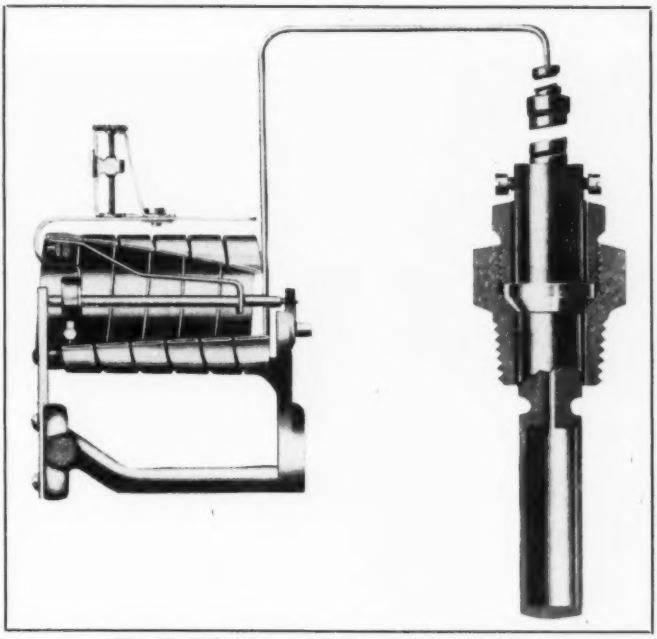


**Fig. 29**—Filled system type temperature instrument

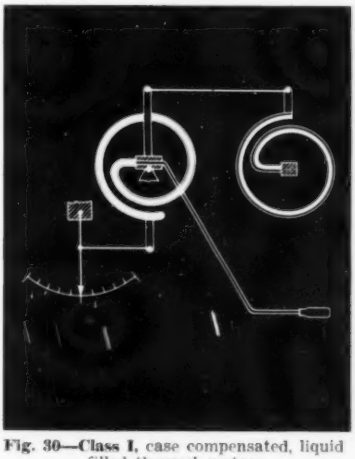


**Fig. 30—Class I,** case compensated, liquid filled thermal system

**Class II**—This class is one of the most widely used of the four groups expansion created by increase of vapor pressure. The thermal system is filled with a volatile liquid and vapor as shown in Fig. 31. As temperature increases, the vapor pressure of the liquid increases, moving the helical spring which records or indicates on a temperature calibrated chart. One advantage of this system is that no compensation is required, because the system is designed so that the surface between the liquid

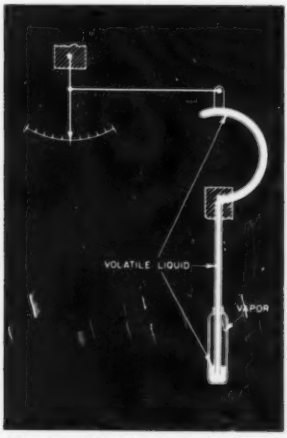



**Fig. 31—Class II,** vapor pressure type thermal system

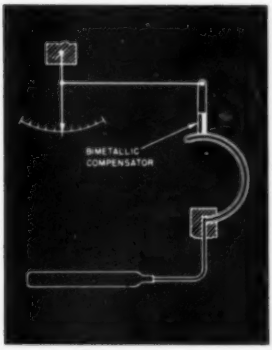



**Fig. 32—Class III,** case compensated, gas filled thermal system

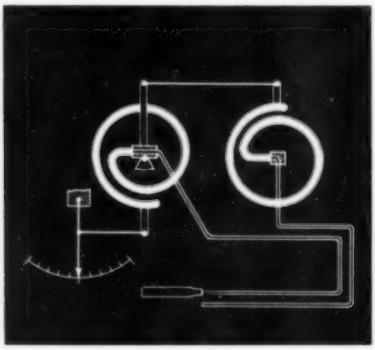


**Fig. 33—Class IV,** fully compensated, liquid filled thermal system

and the vapor is always in the bulb. A good example of how this bulb operates can be had if the bulb is imagined to be a steam generator and the tubing a length of piping to a pressure gage. Care must be exercised in selecting this type for temperatures near ambient, because if the measured temperature crosses ambient conditions, a phase shift will result in the bulb and tubing and may cause serious error. Of all the filled systems, however, this class is the most responsive and also is very accurate. Range of the Class II instrument is −25 to 560° F.

**Class III**—The thermal system of this classification is gas filled. Gas expansion created by increase of temperature is converted into pressure which produces a movement of the helical spring. (See Fig. 32.) The error introduced by the capillary tubing, which is exposed to ambient temperatures, is minimized by increasing the size of the bulb so that the relative volume of the bulb is greater in comparison to that of the tubing. Gas expansion or contraction in the tubing is therefore negligible. If closer accuracy is desired, a bimetallic compensator may be used in conjunction with this thermal system to correct for ambient conditions. This type of system is rarely used in control applications as it is slow in responding to temperature change. This is due mainly to the necessity of the large bulb. The instrument also is not accurate over narrow temperature bands. Range of the Class III instrument is −50 to 1200° F.

**Class IV**—This class differs from Class I, only in that the former is fully compensated while the latter is case compensated. The compensation for Class IV consists of a twin helical spring and thermal system complete except for the bulb, as shown in Fig. 33. The compensating system, subjected to the same ambient conditions as the measuring system, acts as a zeroing device to insure accurate readings. It might be thought of as a differential temperature system. This system offers the highest accuracy obtainable in a mechanical type temperature device. Range of the Class IV instrument is −150 to 500° F.

**PYROMETRIC TYPE** — The great majority of indicating, recording, and controlling temperature instruments in an oil refinery are of the pyrometric type. The origin of this type of device began with the well known principle that when two wires of dissimilar metals are joined together at one end, and are exposed to a temperature higher than exists at the free ends, a small electromotive force is generated. Such an element is known as a thermocouple. The millivoltage generated is directly related (approximately proportional) to the difference in temperature between the junction and the free ends. The fused end is known as the "hot or measuring junction" and is located at the point to be measured, while the opposite ends are carried through leads to an EMF (electromotive force) measuring device. They are referred to as the "cold or reference junction." There are a number of different types of thermocouples to select from; such as iron-constantan, copper-constantan, chromel-alumel, etc. Selection is based on operating temperature as well as service. A typical installation of a thermocouple complete with protecting tube is shown in Fig. 34.

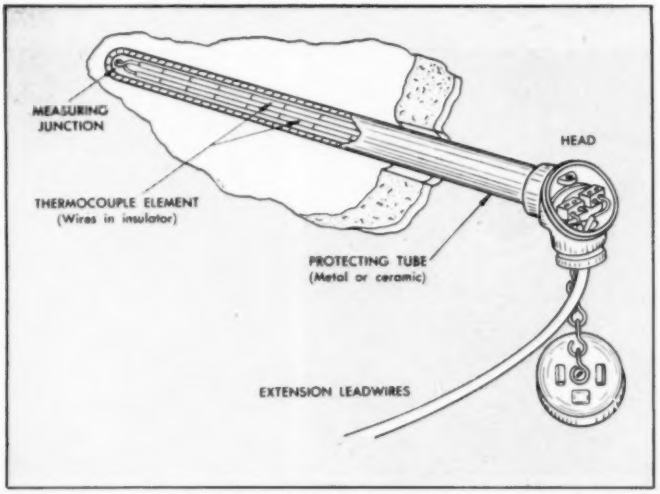


**Fig. 34**—Typical thermocouple assembly (left) and actual installation (right)

The EMF generated by the temperature difference between the two ends is sufficient to deflect the pointer of a d'Arsonval galvanometer. If the scale of the galvanometer is calibrated in degrees and if the reference junction is maintained at a constant temperature, the reading may be interpreted as a measurement of the temperature at the heated end.

One rather important disadvantage in this system lies in the necessity of recalibrating the instrument for any great changes in external resistance which may be created by increasing or decreasing the length of the lead lines.

The more widely used method of temperature measurement is by means of the potentiometer. The potentiometer circuit, as illustrated in Fig. 35, has the advantage that the EMF generated is balanced against a known EMF across the slide wire. This system makes more power available for recording and controlling and also eliminates, for all practical purposes, the problem of recalibration due to changes in lead wire lengths.

A dry cell *B* furnishes a constant flow of current through the calibrated slide wire resistor *CD*. For every position of the slider *P*, a definite difference in potential between *C* and *P* is established (E= IR). It then becomes a simple matter of positioning the slider *P* to a point where the difference in potential between *C* and *P* balances the EMF generated by the thermocouple (denoted when the galvanometer reads zero). This is the reason the system is referred to as the null or zero balance method. In effect, the generated EMF of the thermocouple has been transferred to a calibrated scale in the form of a slide wire resistor. In practice, the scale is divided proportionally to resistance, which can be interpreted as the temperature of the thermocouple *T*. Stating it mathematically:

(1) EMF of the thermocouple $\propto$ temperature of the thermocouple (assuming cold junction is constant).
(2) EMF of the slide wire = EMF of the thermocouple.
(3) EMF of the slide wire $\propto$ resistance of the slide wire (with Constant I: E = IR).
(4) Therefore: resistance of the slide wire $\propto$ the temperature of the thermocouple.

In actual practice, the potentiometer circuit is more complicated, mainly due to the fact that two of the assumptions in the above analysis require some attention to obtain satisfactory results. For example, the current output from the battery *B* will decrease as the battery ages. Secondly, the cold junction reference point will vary with ambient temperature of the junction, which is usually located in the instrument case.

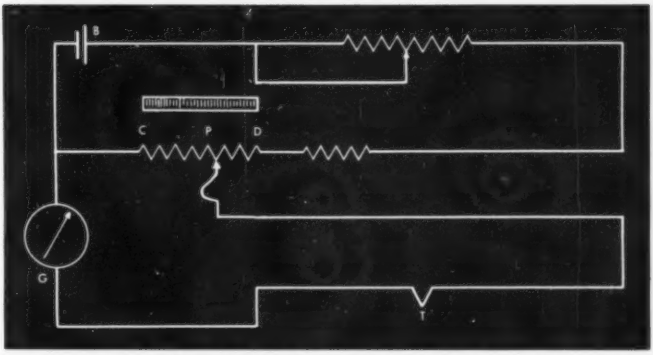



**Fig. 35**—Typical potentiometer circuit

The usual method for checking the battery is to compare its potential at intervals with a standard cell. As shown in the circuit at *A* in Fig. 36, "standardizing" is accomplished by closing the switch to the standard cell. If the galvanometer deflects, the battery rheostat may then be adjusted until the galvanometer reads zero. The battery rheostat may be adjusted manually, semi-automatically, or fully automatically. But for the great majority of refinery applications, the latter two methods are used. The other two circuits shown in Fig. 36 include compensation for change in reference junction temperature.

To begin with, the potentiometer circuit is designed on the basis of a

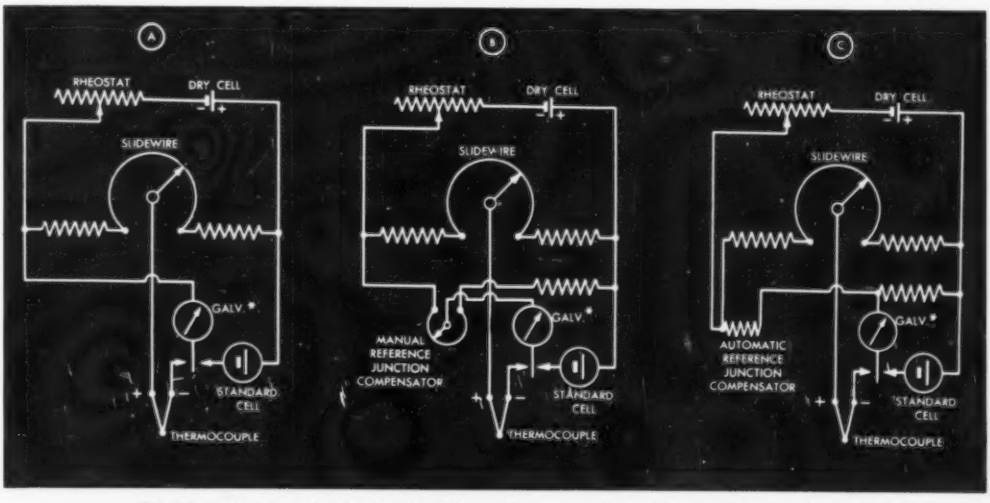



**Fig. 36**—Actual practice for standardizing and compensating with potentiometer circuits

certain reference junction temperature. Since the thermocouple develops a voltage approximately proportional to the difference in temperature between the measuring and reference junction, it follows that as the temperature increases at the reference end, the potential developed becomes less, even though the measuring junction temperature remains constant. To compensate for this effect, the reference junction coil increases in resistance (either manually or automatically), which increases the potential across the reference junction coil the same amount that the thermocouple decreases, thereby in effect adding it to the thermocouple.

If the temperature at the reference junction decreases, the converse of the above description holds true, so that the temperature instrument does not change readings for varying reference junction temperatures. In circuit *B* of Fig. 36, the reference junction is compensated manually by means of a calibrated dial. In circuit *C*, the reference junction is automatically compensated for by means of a nickel wire, which varies in resistance with the temperature.

**RESISTANCE BULB TYPE**—Another, and equally satisfactory means of temperature measurement is by means of a resistance bulb. This bulb operates on the principle that as the temperature to which a resistor is exposed increases, its resistance will also increase. Because the resistance of nickel or platinum wire has a linear relationship with temperature, both are used extensively for resistance bulbs.

One of the advantages the resistance bulb enjoys over the EMF type might be mentioned here. The resistance bulb measures temperature directly, whereas the EMF type measures difference in temperature. As discussed earlier, it is necessary to correct for changes in ambient temperature at the reference junction in order to achieve accurate readings with an EMF type system. Because the reference junction actually represents every electrical connection in the instrument measuring circuit, and because those connections are seldom at the same temperature, errors are introduced. True, compensating elements might be included, but it is questionable if they can correct for every junction in the system.

The principle of the resistance bulb usually is utilized by incorporating it with a Wheatstone bridge. The Wheatstone Bridge circuit as illustrated in Fig. 37 consists of three known resistances and one unknown resistance (the resistance bulb), a source of current, and a galvanometer to detect potential difference. In accordance with bridge theory, there will be no unbalance voltage, as detected by the galvanometer, providing the ratio of the resistances in each branch are equal: $R_1/R_2 = R_3/R_4$.

**Fig. 37**—Wheatstone bridge circuit

To illustrate this point mathematically, assume values for the various resistances and a source voltage of 100 volts, as illustrated in Fig. 37. Since the two branch circuits $R_1R_2$ and $R_3R_4$ are in parallel, they have the same voltage drop. Therefore, the current through branch $R_1R_2$ is $I_1 = 100 \div (100 + 300) = 0.25$ amps. And the current through $R_3R_4$ is $I_2 = 100 \div (200 + 600) = 0.125$ amps.

The potential at $A$ is $(E - I_1R_1)$ $100 - 0.25\ (100) = 75$ volts.

The potential at $B$ is $(E - I_2R_3)$ $100 - 0.125\ (200) = 75$ volts. If switch $S$ is closed, the galvanometer reads zero. Imagining $R_4$ as the resistance thermometer, and that the temperature has increased so that $R_4 = 800$ ohms, a new set of values follows. $I_1$ is still 0.25, and $I_2 = 100 \div (200 + 800) = 0.10$.

The potential at $A$ is still 75 volts.

The potential at $B$ is $100 - 0.10\ (200) = 80$ volts. If switch $S$ is closed again, the galvanometer deflects. The bridge will remain unbalanced until $R_2$, a slide wire, is adjusted so that it is equal to $(R_1 \times R_4) \div R_3 = (100 \times 800) \div 200 = 400$.

If $R_4$ were to have decreased, the potential at $A$ would have been greater than that at $B$. From this point an analogy can be drawn with the potentiometer circuit, in that the variable resistor $R_2$ can be calibrated in terms of temperature.

The Wheatstone bridge may also be used in conjunction with a thermocouple. See Fig. 37 again, but consider dotted line to thermocouple $T$, and consider switch $S$ closed at all times or out of the circuit completely. (Also disregard the ohmages indicated). In this instance, bridge resistor $R_2$ is purposely unbalanced to create a voltage equal and opposite to that of the thermocouple $T$, which would be denoted when the galvanometer $G$ reads zero. It is then a simple matter of calibrating the slide wire resistance $R_2$, in terms of temperature of the thermocouple.

In comparing the use of the thermocouple and the resistance bulb, a few observations can be made. The resistance bulb, besides being a more accurate temperature measuring element than the thermocouple, also enjoys the advantage that it requires neither standardizing nor reference junction compensating equipment. The reason the standardization equipment becomes unnecessary with the resistance bulb is that the bridge balance is derived from the *ratio* of the bridge resistances, thus eliminating the necessity for a constant battery source. The resistance bulb in the bridge circuit does not require reference junction compensation for reasons already discussed. It should be mentioned, however, that thermocouple elements, beside covering a wider range, are less expensive than resistance bulbs and are therefore used more extensively. On the other hand, manufacturers have continued to increase the range of the resistance bulb, and where absolute accuracy is required, the bulb is superior as long as the operating temperatures remain with the range of the bulb.

## *Future Articles*

After the next in this series of articles on refinery instrument fundamentals, which will deal with recording temperature instruments, future articles will be published on controllers, control valves, and on transmitters.

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ISA MEETING

# Are Tomorrow's Instruments Here Today?

## Rapid progress reported at show in Houston in use of electronics, servo mechanisms, and automatic analyzers for process control

By WILLIAM C. UHL
Equipment Editor

SIGNIFICANT trends in instrumentation for petroleum processing continue in the direction of automatic push-button refineries and petrochemical plants, once regarded as virtually idle day-dreams.

This was emphasized again and again at the Sixth National Instrument Conference and Exhibit, Sept. 10-14, in Houston, Texas. Points of interest to the petroleum processor, brought out in the technical papers, in the various displays on the exposition floor, and in conversations, luncheon addresses, etc., include:

1. Process control is leaning toward greater utilization of the so-called servo mechanism techniques.

2. Electricity and electronics are gaining a firm footing as an operating medium for process control equipment.

3. Automatic analyzers of various types have reached the stage in development where they are being accepted and used for continuous recording in the monitoring of petroleum and chemical product quality.

"It is inevitable that at least some of these continuous analyzing instruments will, in the near future, control product quality,' it was stated by Mr. James Harrop, general superintendent of Humble Oil & Refining Co.'s Baytown refinery, in a luncheon address before the Scientific Apparatus Makers' Ass'n. during the Houston conference.

He described the progress of instrumentation during the last several decades as being one of three distinct "ages." First, there was the age of recorders, then the age of controllers, and now—since about 1945—we've been living in the age of analyzers.

The future can be easily visualized as going on to controller-analyzer; always including, by necessity, of course, the usual instrumentation for checking the conventional physical variables.

"It is certainly conceivable," Mr. Harrop added, "that some time in the future, yield information will be transmitted directly from the process to the accounting departments."

### Types of Analyzers at Baytown

Automatic analyzers in use at Baytown, as described by Mr. Harrop, are as follows:

"An infrared analyzer has been applied to the determination of the carbon monoxide content of flue gas at one of the Fluid catalytic cracking units. An analyzer operating on the magnetic susceptibility principle is measuring the oxygen content of regenerator flue gases at both catalytic crackers, and others are in a similar service at the Hydroforming unit. At the Hydroforming unit these instruments guide the regeneration of beds of catalyst worth over a half million dollars, and it is hoped that they may make it possible to increase the life of the catalyst by several fold.

"At the catalytic crackers, the information from such analyzers helps minimize after-burning with its damage to catalyst and equipment. Instruments functioning on the capacity, or dielectric constant, principle are being used in the measurement of the aromatic content of certain refinery streams."

Many new designs in process control equipment were seen among the approximately 175 different displays in the exhibition by an estimated 6500 conference registrants who braved the rigors of the non-air-conditioned Houston Coliseum. Among those of interest to petroleum men were:

1. An automatic numerical data recorder, or telemeter, which transmits signals of process variables from the primary measuring element to a remotely located machine similar to a teletypewriter where data is printed rapidly in tabulated form. Already proved in several years of service for electric power distribution, the machine may be seen as a means for sending process data to the refinery accounting office, for example.

2. Several improvements in high-speed transmission, both pneumatic and electric, designed to reduce time lag difficulties.

3. One completely new control system in which transmission is entirely electrical, having instantaneous action of the final element, with no time lag.

4. High-speed scanning equipment, electrically-operated, which can provide continuous sequential recording of large numbers of a specific process variable at rates up to 90 per minute or higher.

Instrument engineers are not as yet in complete agreement as to the precise value of servo-mechanisms. However, many in attendance at Houston concurred that the servo techniques will provide an important new tool for solving process control problems.

There also is still no exact definition of the term. It can perhaps be best described by example. It was the servo mechanism method of approach that achieved the almost unbelievable results in the military and aviation fields in recent years with automatic, pilot-less, flight control of aircraft; automatic gun- and bomb-sights; remote positioning of searchlights and gun turrets; radar scanning, and the like.

That the servo mechanism idea is of intense interest and value as a potentially beneficial tool was evidenced by the well-attended panel program on the subject sponsored by the ASME Instruments and Regulators Division, as well as several other technical papers during the Houston conference. It was emphasized by all speakers that the technique will require a greatly increased cooperation among instrument engineers, process engineers, and design engineers. Close combined effort on the part of both instrument users and manufacturers alike is also necessary for continued progress in the field.

Basically, the servo technique seems to offer a tool for expressing process control problems in terms of numbers. In a paper entitled "Practical Application of Servo Mechanism Techniques to a Process Control Problem," S. P. Higgins, Jr., and G. W. McKnight, Minneapolis-Honeywell Regulator Co., showed the usefulness of servo methods for predicting system behavior on an actual process.

The actual test described was a simple flow control system built in the laboratory and having sufficient physical significance to be associated with actual processes. It consisted of a centrifugal pump circulating water from the bottom of a tank, around a closed loop of pipe, and back into the top of the tank. Flow was measured by conventional orifice methods. The lengths of pneumatic tubing connections between the meter, controller, and a control valve in the flow line could be varied to show the response for a process-mounted controller as well as for one mounted in the control house. In addition, flow meters of the mercury and the dry type were tested with the controller in these locations. A signal

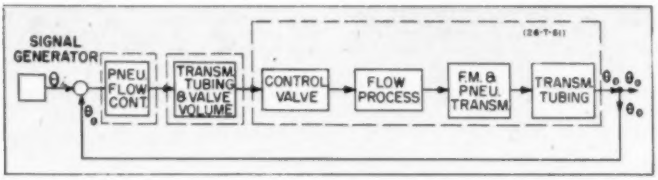
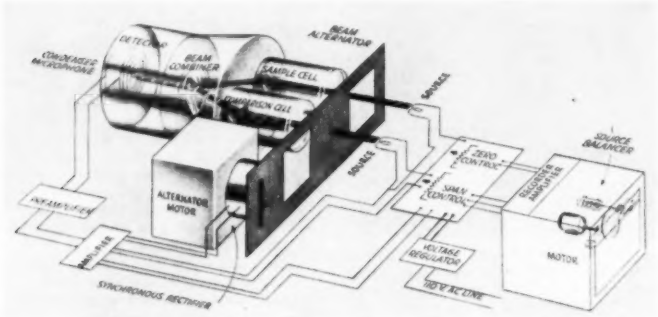



**Fig. 1**—Block diagram for servo mechanism technique on simple flow control system




**Luft-type infra-red analyzer** for continuous analysis of either gases or liquids

generator, hooked in to the controller, was used to load the system or system components with a sinusoidally varying disturbance.

### Block Diagram Method

"The various elements of the system can be represented by a series of blocks as shown in the diagram in Fig. 1," the paper stated. "The signal generator is an analytic tool only and forms no part of the automatic flow system. Breaking the system up in the parts indicated by the blocks is done so the parts may be isolated as needed for analysis and design. The ultimate objective is to identify or tag each block so the design of each can be determined for optimum performance of the system as a whole.

"This, in the language of the servo mechanism engineer, is a method offering means for analysis of the elements or blocks that exist already, or for the synthesis of those yet to be designed. It may be more convenient, in certain cases, to have the block represent two or more components in the system, such as the valve and the process. This individual transfer function for the process could then be obtained if the valve transfer function (the response in valve position to valve pressure) were known. The dotted blocks in the diagram show one instance where transfer function across a group of components might be studied, rather than the individual transfer functions of the components themselves."

"The development of this technique is in its early stages. An examination of the blocks to be analyzed shows that some are under the jurisdiction of process designers and plant operators while others are the responsibility of instrument manufacturers.

"When the methods have been exploited we may reasonably expect them to perform many useful functions." Among these are:

1. Allow predictions of system performance to be made from tabulated information on performance of individual components of the system.
2. Establish the necessary response characteristics which an instrument *or a process* being designed must have in order to make the complete system in which it is installed operate as desired.
3. Allow the designer to determine the source of undesirable effects and to minimize their effect, either by a change in process or instrumentation, or by intelligent compromises.
4. Allow comparison of the performance of various processes as well as other components where a number of choices is available.
5. Performance can be predicted, so that in the selection of equipment, performance may be discussed along with other major factors such as the economics, convenience, maintenance, etc.

### What Should Be Controlled

The ASME symposium on servo mechanisms and their effects on the future of industrial process control was followed by a lengthy period of open discussion by the large audience. An important question posed during this time was: What is the most important or critical variable that should be controlled?

J. B. McMahon, Republic Flow Meters Co. and 1950-51 president of the Instrument Society of America, suggested:

"I think there is one thing the servo mechanism engineers haven't paid sufficient attention to; and that is the selection of what you're going to control. The servo field has been very largely devoted to the control of machines. And those who have done most of the mathematical work have assumed that you can control anything you can measure. That, I believe, is far from the case. . .

"I would like to give one example of a difficult one to handle. That is merely the control of comfort in a domestic residence. During a severe winter, at some time or another your wife will say to you, 'I'm cold.' So you go over to the thermostat and it is functioning properly and indicates the right temperature, and so you say to the wife, 'Well, now, that's alright: you're not cold. The temperature is all right.'

"Of course, there is some discussion back and forth and eventually you go back and move the thermostat up. And you do that as a concession and probably feel it is against your better engineering judgment to do so. The difficulty is that your wife was right. She was cold. It was probably a very cold night outside, and human comfort is affected by things other than air temperature: radiation, air circulation, and humidity, to name a few.

"Now, that is a very homely example of something we are encountering continually in process work. Distillation column performance has been referred to here. . . If you try to tie this sort of thing down too tight from a theoretical control standpoint, you are going to interfere with fractionation. And after all, the prime function of a fractionator is to fractionate, and all the controls we have been able to apply so far to fractionating columns have been purely on the basis of empirical experience. . ."

### Take It Easy

A word of caution was urged by A. F. Sperry, Panellit, Inc., and executive chairman of the ASME Industrial Instruments & Regulators Div.:

"Maybe we've given the impression to a lot of people that we expect to solve all process problems. . . What Mr. McMahon said about fractionating columns is absolutely true. If something goes haywire, you can put all the derivatives in the world on it, but you won't have any product.

You'll disturb the thing much worse in trying to correct it. You'll almost invariably go too far and create a second disturbance which is worse than the one you were trying to correct in the first place. . . .

"In a modern big oil refinery—which is a whole chain of processes—you just don't let disturbances happen. . . When I first got acquainted with refinery practices—only in the last five years or so—I was astounded at the number of flow controllers. I knew the chemical plant practice a little more. There's more tendency in the chemical plant to have parts of a process independent of each other. When something goes wrong you can take corrective action because that usually terminates it—it usually goes into a storage tank.

"But when you get into a refinery process and apply that corrective action, the rest of the thing is likely to go haywire. So you find that the general tendency in the refinery is to put flow controllers in to prevent any kind of a disturbance. As a matter of fact, to a great extent you don't control at all, you just keep the necessity for the control out of the process.

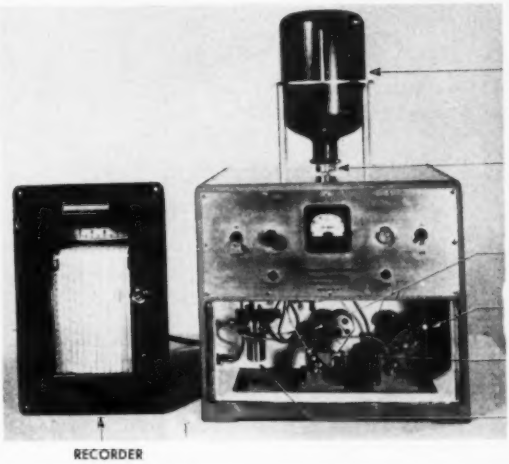
"Now that doesn't mean it isn't going to come. . . When some of these newer methods of measuring what is *actually* going on in some of these processes are more fully developed, then maybe we can get this information faster to the controllers."

### Continuous Analyzers

This same need for measuring the proper variable in a process, perhaps its chemistry, was mentioned before in this article in Mr. Harrop's remarks about continuous analyzers. It was also brought out in three other technical papers during the conference: two on two different designs of infra-red analyzers, and another on a continuous recording electrometric titrometer.

As of now, two basic types of analyzers have been developed for commercial, in-the-plant or on-the-unit application of infra-red radiation. One, the selective detector type of non-dispersion instrument, will analyze continuously either gases or liquids. It was described in a paper, "An Improved Luft-Type Infrared Gas and Liquid Analyzer," by James L. Waters of James L. Waters, Inc., and Nelson W. Hartz, Mine Safety Appliances Co.

The instrument is said to provide practical detection of water in alcohols, ketones, benzene, and other hydrocarbons. Also possible is the measurement of hydrocarbon mixtures of alcohols and ketones, petroleum hydrocarbon mixtures, and others. On the gaseous phase, representative applications include: Carbon monoxide in ammonia synthesis and in hydrogenation gases; propane and butane in natural gas; water vapor in process gases; toxic gas detection, and measurement of reformer efficiencies (by analyzing compounds produced).




**Mercaptan analyzer** of Shell Development, described as a "continuous recording electrometric titrometer"

The other type of infra-red analyzer is the so-called non-selector, non-dispersive type. It was described in a paper, "Application of Continuous Infrared Analyzers," by J. M. Devine, Baird Associates, Inc., in a session of Texas A&M's Symposium on Instrumentation for the Process Industries, a part of the Houston conference.

Recent applications cited for this device in the paper included: n-Butane in methane, ethane, propane, isobutane, CO, and $CO_2$; methane in natural and manufactured gas blends; acetylene in 14-component mixture; methane in 14-component mixture; carbon dioxide in 7-component mixture, and ammonia in 7-component mixture.

Another approach to the problem of process stream analysis is an instrument for determining mercaptan content in solutizer-sweetened gas line. It was described in the paper "Continuous Recording Electrometric Titrometer," by K. E. Hallikainen and D. J. Pompeo, Shell Development Co.

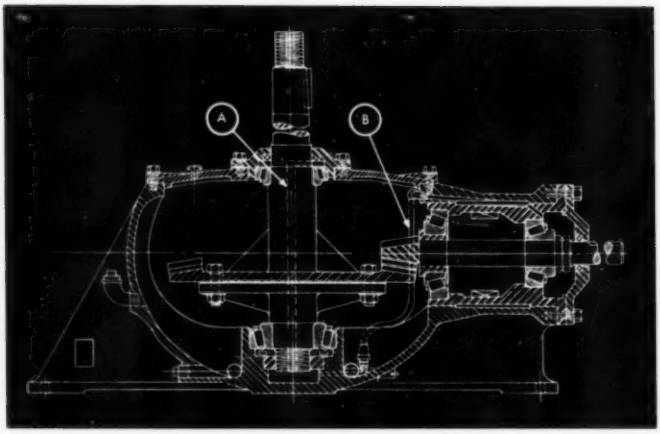
The automatic titrometer is now in operation in a refinery, the authors stated. Operation has not been sufficiently long to provide results of long term performance, particularly as to maintenance requirements under plant operating conditions. However, no difficulties have arisen so far, and it is expected that the instrument will continue as an aid to the operators in detecting upsets and minimizing their effects.

Basically, the instrument consists of two Zenith gear pumps—one for pumping the liquid to be titrated at a constant rate, and the other for pumping the titration liquid at a rate to keep the combined solution at an equivalence value. The pumping rate of the titrating liquid is controlled by the electrometer. This varying rate of pumping is then recorded directly as the percent mercaptan present.

### Electronics vs. Time Lag

An all-electronic control system for such process variables as pressure, flow, temperature, and level was shown on the exposition floor for the first time by The Swartwout Co. in their so-called "Autronic" control system. The transmission portion of the system is entirely electrical, and is reported to operate on extremely low voltages for any length of line from primary to final element up to distances of over 1000 ft. An interesting feature is that all the units, control, recorder, and manual control, are of the new miniature size required in the modern graphic instrument panel.

The control unit is being made in three basic models, with or without built-in set-point adjustment. They are proportional; proportional and reset; and proportional, reset, and rate control, actions. The system can be operated with or without the recorder, and without recalibration. Final element in the system is a high-capacity air pilot mounted on a standard pneumatically operated valve. Voltage changes from the control unit modulate the air supply pressure to position the valve.



*Drawing and photo courtesy of The Marley Co.*

**Fig. 1—Forced feed lubrication** installed in these cooling tower gear reducers lowered maintenance costs

# Gear Reducer Upkeep Is Cut 85%

## Forced feed lubrication system at cooling tower lowers annual costs to $600 and pays out in one year

**By C. D. CRAWFORD**
***Standard Oil Co. (Ohio)****

HIGH maintenance costs on cooling tower gear reducers have been decreased approximately 85% as a result of a forced feed lubrication system, developed and put into service two years ago at the Cleveland No. 1 refinery of Standard Oil Co. (Ohio). The savings have enabled Sohio to pay off the original cost of the lubrication system in its first year of operation.

Prior to the installation, which represented an investment of about $3000, maintenance on the twelve 60 hp. gear reducers ran an average of $3050 annually—$4000 in 1947 and $3300 in 1948. After the lubrication system was installed, the maintenance dropped to an average of $600 yearly in 1949 and 1950. Man-hours are included in all maintenance cost figures. In addition, it has not been necessary to change the oil in the gear reducers every 3000 hrs.

The cooling tower at the plant comprises a 12-cell unit with 12 induced draft fans, each rated at 800,000 cfm. The fans are driven by 60 hp. motors through gear reducers with a ratio of 8.66. Fig. 1 shows the cross section of one of the reducers. The threads on the bottom of the vertical shaft act as a pump to move oil to the top bearing through the hole A drilled in the fan shaft. Oil is also pumped to the bearings on the pinion shaft through the oil line B.

Within a year after the cooling tower went into service in 1943, extremely high maintenance was encountered in the gear reducers. The bearings and gears wore out at a higher than normal rate. Every time repairs were made, water was found in the oil. The emulsion formed destroyed the lubricating properties of the oil, and the bearing and the gear teeth wore away.

Flingers were installed on the vertical fan shafts to try to prevent water from running down the shafts. These devices had no appreciable effect in preventing water from getting into the gear boxes. Exactly how the water entered the boxes was never determined.

Sohio finally decided to develop a forced feed lubrication system which would circulate oil through the gear reducers. This system would remove the water from the gear box as fast as it entered; would clean the oil through a filter; and would eliminate the necessity for changing the oil periodically.

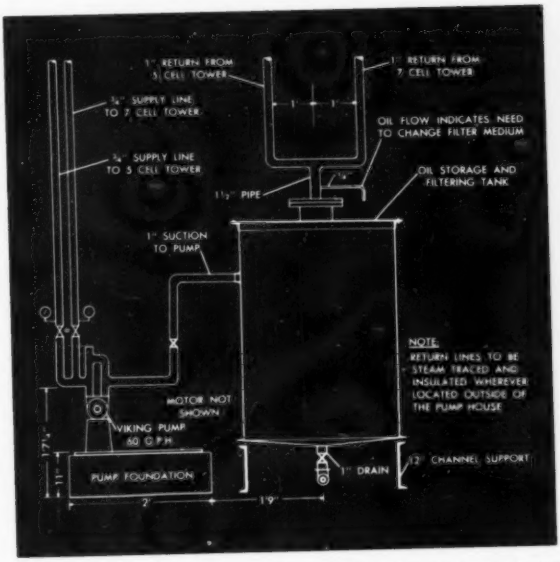
The oil change, every 3000 hours, had proved very expensive. It was necessary to build a scaffold in the cooling tower under the gear box so that the men could work safely. The large refinery crane was required to lift the 55-gal. drums of new oil to the top of the cooling tower. Also, it was necessary to take the fans out of service while the oil change was being performed. And finally, machinists had to remove the oil from the gear box and add the new oil.

The forced feed system as finally installed consisted of a pump, a filter, and a settling and storage drum located in the cooling tower pump house. A supply header was run to the gear reducers and a return header from the reducers back to the oil filters. An individual oil line ran from the header to each reducer and tied in at the top bearing. To distribute the oil equally to each gear box, an orifice 0.03 in. in diameter was installed in each supply line. This was designed to admit 5 gals./hr. to each gear box. The capacity of the box is 6 gals., so the oil is changed completely every 72 minutes.

Fig. 2 shows the arrangement of the equipment in the pump house. The oil storage and filtering tank has a capacity of 113.5 gals. up to the pump suction line near the top. The purpose of taking suction at the top of this tank is to provide retention time so that any water in the oil can drop out. Water can be drained from the bottom of the settling tank through the 1-in. drain valve. The two return lines join together at the filter inlet.

The filter design is illustrated in Fig. 3. It comprises a piece of 6-in. pipe packed with glass wool. This filter medium not only catches any dirt and foreign material in the return oil, but also helps separate the water from the oil. After the oil passes down through the filter, its velocity is reduced by the large diam-

* Mr. Crawford is superintendent of the utility department at Sohio's No. 1 refinery, Cleveland, Ohio.


1" RETURN FROM 5 CELL TOWER
1" RETURN FROM 7 CELL TOWER
¾" SUPPLY LINE TO 7 CELL TOWER
OIL FLOW INDICATES NEED TO CHANGE FILTER MEDIUM
¾" SUPPLY LINE TO 5 CELL TOWER
OIL STORAGE AND FILTERING TANK
1½" PIPE
1" SUCTION TO PUMP
NOTE
RETURN LINES TO BE STEAM TRACED AND INSULATED WHEREVER LOCATED OUTSIDE OF THE PUMP HOUSE
MOTOR NOT SHOWN
VIKING PUMP 60 G.P.M.
PUMP FOUNDATION
1" DRAIN
12" CHANNEL SUPPORT

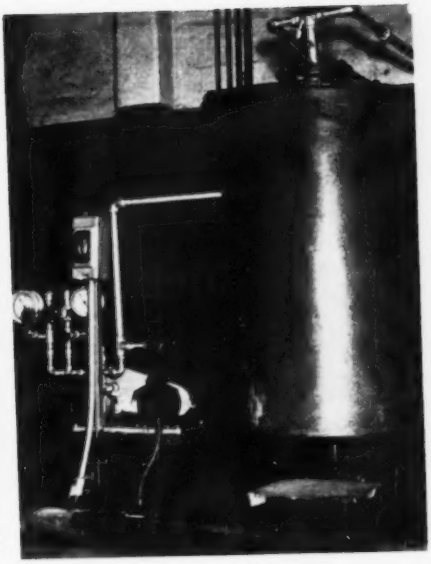


**Fig. 2—Lubrication system** as installed in Sohio's pumphouse

eter of the settling tank, and the water will drop out to the tank bottom. The oil rises slowly to the pump suction line and then passes on to the two supply lines at about 45 psi. pressure.

Fig. 4 shows the arrangement of the piping at the top of the cooling towers. Each gear reducer has an individual supply line with a shutoff valve. Neoprene tubing is used at the reducer to eliminate the possibility of line breaks from vibration. The orifice in the supply line is located outside the fan housing for accessibility. It has been found that the orifice will plug occasionally and need cleaning. The return line is taken from the bottom of the gear reducer because that is the best place to remove the water. In order to hold the proper oil level in the gear reducer, the return line is run upwardly the required distance and then down to the return header. A ¼-in. vent is provided at the top of this loop to prevent siphoning. It can be removed readily by the operators. The opening is used as an inspection port to check on the oil circulation. Failure to find any oil in the return line indicates that the supply line orifice is blocked. The return line is steam-traced and insulated to keep the oil warm enough for flow in the cold months.

The forced feed lubrication system was put into service on January 15, 1949. Since that time only two gear reducers have had repairs to the gears or bearing. The only maintenance on the system has been to take care of the occasional blocking in the orifices, and this becomes less frequent as time passes. In two years, it has not yet become necessary to change the filter medium in the pump house unit.

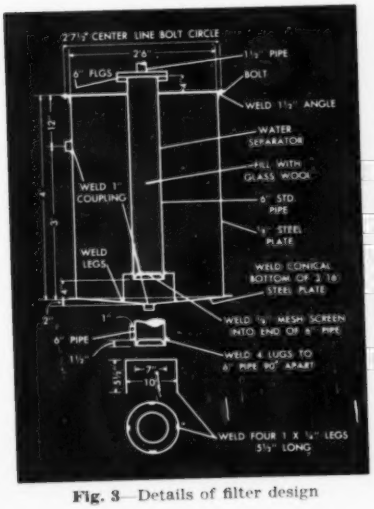



**Fig. 3**—Details of filter design

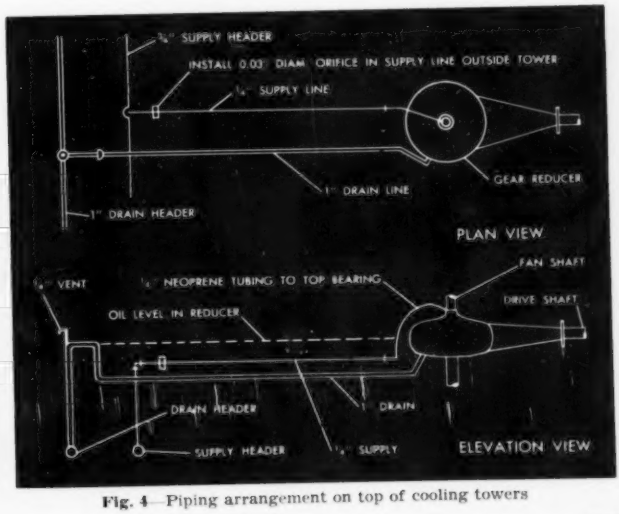



**Fig. 4**—Piping arrangement on top of cooling towers

WHAT? YOU WANT THAT BUNDLE REMOVABLE? SPECS DON'T SAY SO!
GLOOP !!
YEAH, BUT IT WOULD BE EASIER TO MAINTAIN -- AND SAY, WILL YOU CHOP ABOUT 3 FEET OFF THE TUBES TO GIVE US MORE ROOM?
ENGINEERING DEPARTMENT

No. 4 in a series on How to Order Equipment

# How to Get What You Need When You Order Heat Exchangers

*By D. P. THORNTON Jr., Southwestern Editor*

HEAT exchangers cannot be ordered from catalogs, as can valves, pipe fittings, fire-brick and similar "standard" equipment for refinery and natural gasoline plant use. Perhaps this is a good thing, for buyers fail to appreciate manufacturers' problems frequently enough as it is. Even so, there are many things which the prospective buyer can do to expedite quotations and deliveries by avoiding unnecessary "frills," saving both his time and the manufacturer's.

These advantages can be had for only the slight cost of using reasonable care in supplying complete, uncomplicated specifications when asking for a quotation or on purchase orders. The information needed ordinarily will not require more than half-sheet of standard letterhead to list.

Unfortunately, too many specifications either are incomplete or place entirely unnecessary restrictions on the manufacturer. Generally, most inquiries give that vital information without which a heat exchanger, reboiler or condenser cannot be designed. But the general tendency is to omit or guess at other important supplementary data and include too many unnecessary matters.

Furthermore, even though exchanger "catalogs" as such never are available for general distribution, every manufacturer has them. These, however, catalog his standard, basic designs; they do not refer to on-the-shelf items or parts already fabricated. They are grouped in pressure and temperature classifications, service applications, heat-transfer surface ranges, and for commonly-used materials in tubes, tubesheets and shells.

If the buyer's requirement can be met by one of these "standard" designs, then delivery time is materially shortened.

### Basic Design Data

Characteristics of most of the ordinary petroleum products are so well known that usually it is sufficient to name a product and give its specific gravity (by any standard method and preferably under operating conditions); in certain cases viscosity also is needed. This is true only because, through the years, heat transfer experts have built up a fund of information and experience through cooperation with oil companies.

It is not necessary to quote extensively from standard codes, such as API-ASME. Just specify the code and any appropriate revision. Copies are readily available to manufacturers; most designers can recite large sections from memory. Exceptions only should be stated; never make them without a good reason.

If the buyer has a "company code" he should take a

**Fewer mistakes in listing specifications** for heat exchangers will occur if a standard form sheet such as is illustrated on the facing page is used. In this example, data furnished by buyer is shown in black, data developed from this by manufacturer is shown in color.

### Reprints Available on Valve Articles

Reprints have been prepared for the first three articles in this series on "How to Order Equipment"—July, pp. 722-24; August, pp. 844-47; September, pp. 974-77. They cover the subjects of valves, both manually-operated and non-manually-operated, and pumps. Single copies may be obtained without charge by writing:

Reader's Service Department
PETROLEUM PROCESSING
1213 West Third St.
Cleveland 13, Ohio

Price quotation for quantities will be furnished on request.

# EXCHANGER SPECIFICATION SHEET

| | | | |
|---|---|---|---|
| CUSTOMER | | JOB No. | 3191 |
| | | REFERENCE No. | |
| ADDRESS | | INQUIRY No. | 7614 |
| PLANT LOCATION | | DATE | 8-10-51 |
| SERVICE OF UNIT | Third stage gas cooler | ITEM No. | C-3 |
| SIZE 15-16-505 | TYPE: HFR | CONNECTED IN | Parallel |

Floating head with removable tube bundle.

SURFACE PER UNIT 1010 ft.$^2$ SHELLS PER UNIT 2 SURFACE PER SHELL 505 ft.$^2$

## PERFORMANCE OF ONE UNIT

| | SHELL SIDE | TUBE SIDE |
|---|---|---|
| FLUID CIRCULATED | Hydrocarbon liquid & vapor | Water, treated |
| TOTAL FLUID ENTERING | 72,947 #/hr. | 592 gpm. available |
| VAPOR | 33,766 #/hr. 46.6 M.W. | |
| LIQUID | 38,448 #/hr. 0.657 grav | |
| STEAM | 733 #/hr. | |
| NON-CONDENSABLES | 11,099 #/hr. 34.13 M.W. | |
| FLUID out | 61,115 #/hr. 0.622 grav. | |
| STEAM CONDENSED | 672 #/hr. | |
| GRAVITY Avg., water = 1 | Vap-0.0157; Liq-0.585 | 1.0 |
| VISCOSITY cp. Avg. | Vap-0.0107; Liq-0.18 | --- |
| MOLECULAR WEIGHT—VAPORS | | |
| SPECIFIC HEAT—LIQUIDS | Vap.-0.475; Liq.-0.575 B.T.U./# | 1.0 B.T.U./# |
| LATENT HEAT—VAPORS | 122 B.T.U./# | --- B.T.U./# |
| TEMPERATURE IN | 200 °F | 82.5 °F |
| TEMPERATURE OUT | 120 °F | 105 °F |
| OPERATING PRESSURE | 150 #/SQ. IN. | 35 #/SQ. IN. |
| NUMBER OF PASSES | 2 | 1 |
| VELOCITY | FT./SEC. | FT./SEC. |
| PRESSURE DROP | 7 (maximum) 5 #/SQ. IN. | 5 (maximum) 3 #/SQ. IN. |
| Fouling factor | 0.0005 | 0.0002 |

HEAT EXCHANGER—B.T.U./HR. 6,647,000 M. T. D. (CORRECTED) 56.5°

TRANSFER RATE—SERVICE 118 CLEAN 164

## CONSTRUCTION

| | | | |
|---|---|---|---|
| DESIGN PRESSURE | 200 #/SQ. IN. | 75 #/SQ. IN. | |
| TEST PRESSURE | 300 #/SQ. IN. | 115 #/SQ. IN. | |
| DESIGN TEMPERATURE | 400 °F | 300 °F | |

TUBES Admiralty No. 161 O.D. 3/4" BWG. #16 LENGTH 16' MAX. PITCH Triangular 15/16"

SHELL Steel pipe, 15¼" I.D. O.D. 16" nom. THICKNESS 3/8"

| | | | |
|---|---|---|---|
| SHELL COVER | Steel | FLOATING HEAD COVER | Steel |
| CHANNEL | Steel | CHANNEL COVER | Steel |
| TUBE SHEETS—STATIONARY | Steel | FLOATING | Steel |
| BAFFLES—CROSS | Steel TYPE | THICKNESS | |
| BAFFLE—LONG | Steel TYPE Impact | THICKNESS | |
| TUBE SUPPORTS | Steel | THICKNESS | |
| GASKETS | Mnfr. Std. | | |
| CONNECTIONS—SHELL—IN | 6 in. OUT 6 in. | SERIES | 300 lb. |
| CHANNEL—IN | 6 in. OUT 6 in. | SERIES | 150 lb. |
| CORROSION ALLOWANCE—SHELL SIDE | 1/8 in. | TUBE SIDE | None |

CODE REQUIREMENTS API-ASME, Stamp Req'd. TEMA Construction

WEIGHTS—EACH SHELL BUNDLE FULL OF WATER

NOTE: INDICATE AFTER EACH PART WHETHER STRESS RELIEVED (S.R.) AND WHETHER RADIOGRAPHED (X-R)

REMARKS:— Minimum of TWO (2) shells, in parallel.

long look at it annually to see if some of those special restrictions are unnecessary, being adequately covered by generally-accepted codes. Perhaps sections have become outmoded because of technological advances in heat transfer, hydraulics and metallurgy.

The buyer may wish to make use of a standard tubular exchanger code in his fabrication specifications which has been developed by the Tubular Exchanger Manufactures Assn. (T.E.M.A.) covering mechanical design. There have been two editions of this code published, the latest in 1949. The TEMA Code has been prepared by a committee of authorities chosen by the membership and is said to incorporate the best of design practices in its requirements. Contained in its provisions is a statement to the effect that it supplements and includes requirements of the API and ASME codes for unfired pressure vessels.

When fluids other than oil, water and steam are involved, the physical characteristics should be given unless they are so common that authoritative data can be obtained readily. If the buyer supplies these data, he must accept sole responsibility for their accuracy.

The chemical industry, in general, is particularly extreme in refusing to divulge the nature of fluids involved, although usually very good about supplying their characteristics. The exchanger manufacturer does not particularly care to penetrate this "iron curtain" so long as the needed information on physical and heat transfer characteristics are set forth. But he will rightfully object when asked to guess.

Inlet and outlet temperatures and the quantity of at least one fluid, and the inlet temperature for the other must be specified, plus respective operating pressures. Stating the maximum conditions also is advisable, such as might occur in a process upset, since allowing for them may some day save the trouble of buying an emergency replacement.

With these bare essentials and reference to his knowledge and experience, theoretically, the manufacturer can design a heat exchanger. The word "theoretically" is used advisedly.

Unfortunately, sketchy specifications and the "you-guess" varieties are not rarities.

Several extremely important bits of information still are missing, data which will help the designer materially in giving the buyer the best possible exchanger for his need. If one of the fluids is crude oil, heavy fuel and so on, what is the viscosity (at two temperatures)? Are some vapors or non-condensables present? How much, and must any vapors be condensed? How much corrosion allowance? Are the fluids dirty? Is there likely to be coking? Any maximum length restriction? What materials for tubes, tubesheets and shell? Nor are all the applicable questions which it might be advisable to answer on occasion.

A heat exchanger is a relatively simple device, but how exasperating when the manufacturer is told, after he has completed the design without this information, that:

1. Only a 5 psi. pressure drop can be tolerated, instead of no limitation;
2. A 16-ft. tube bundle will be too long;
3. The bundle must be removable;
4. Floating head design is desired, or
5. Square pitch is a "must."

These are not uncommon occurrences and materially changing any one can require almost complete re-design.

It's even worse when the manufacturer is blamed later for excessive maintenance because the exchanger fouls rapidly from dirty liquid, when the buyer said nothing about it in his specification and only normal fouling factors were applied in design.

An amusing experience of a well-known manufacturer points up to desirability of furnishing supplementary information. A coil-in-shed exchanger blew to bits shortly after installation; the buyer inferred either faulty metallurgy or fabrication despite certifications and a code stamp. A sales engineer was dispatched to the plant, took metal samples and generally examined the wreckage. Associated piping revealed no obvious cause for excessive pressure.

Finally, by accident, the investigator found that a pressure regulator located underneath the compressor house floor had been installed to by-pass high pressure gas to the defunct exchanger, which had been designed for relatively low pressure. The explosion occurred because the regulator had failed to regulate. In fairness to the customer, however, it was further found that the plant crew had gadgeted this arrangement without consulting the home office engineering department and consequently the latter's complaint had been made in good faith.

### Provision for Upsets

Such a situation makes pertinent a suggestion of exchanger manufacturers which often is viewed with suspicion by buyers. Advise the manufacturer not only the working pressure and temperatures, but the anticipated maximums on the equipment in an emergency—be realistic. Designed accordingly, the exchanger can take a process upset in stride. This may or may not increase the cost of the exchanger, but the insurance value and safety considerations are obvious.

Another manufacturer's experience with "things which can't happen" is the case of the steam-heated propane evaporator which froze up and burst its tubes. It was finally proven that the gas was being withdrawn at such a rapid rate that the shell pressure went far below design expectations. The boiling propane thus reached such a low temperature that steam condensate in the lower passes was frozen, regardless of the fact live steam continued to enter the exchanger.

### Less "Spec" Restrictions

There are several reasons why the exchanger manufacturer asks for less-restrictive mechanical specifications in these days of material scarcities; in peace-time he does not care. The Houston representative of a large manufacturer puts it this way:

"The kindest thing the customer can do for us is to suspend any 'custom' standards he normally uses. Instead, advise the process conditions the exchanger must meet, omitting such frills as shell diameter, nozzle location, shell thickness and so on. Restrict removable tube bundle lengths to a maximum only when installation space is at a premium; be as liberal as possible. Then we can supply a 'standard stock design' which will amply fulfill his requirements.

"The 'off-the-shelf' design may be slightly larger than he might have received in a 'custom' design, because his may be a borderline case between two standard sizes. Generally it will be slightly smaller—if we think he can get by with it—because his process engineer probably

added a 5% safety factor in his calculations, the contractor likely jumped this 5 to 10% more, and we normally might add still another 10%.

"Many customers now are requiring U-tube construction for high-pressure exchangers, which is fine. But for some obscure reason they favor long, thin exchangers asking for 20 ft. bundle lengths. From a manufacturing standpoint this is impossible because standard tube lengths are 36 ft. maximum in steel and often we cannot secure more than 32 ft. lengths. This effectively limits us to 16 ft. bundles because, from corrosion and maintenance standpoints, it is inadvisable to weld two tube lengths together."

A suggested way of preventing a pile-up of safety factors is to: (1) report the performance design specifications *without* benefit of "safety factors" and so state, (2) advise the exchanger manufacturer what safety factor he is to use in design (10% for example) or, (3) tell him how much "fat" has been used in developing the data he is to use for exchanger design. Then the manufacturer can apply his judgment and experience to the buyer's best advantage.

The principal point to be remembered is that heat transfer design data are no more accurate than the experimental conditions or empirical considerations from which they were derived. Usually this accuracy is about 10% in excess of the theoretical to take care of experimental variables which are difficult to control or determine, and also variations in commercial operations which may or may not coincide with experimental situations.

Illustrating unduly restrictive requirements is the "what not to do" story of another manufacturer. He was given all the process conditions with the added injunction from the chief engineer that he was "tired of getting a peanut piece of pipe instead of an 'exchanger.'" A 24-in. O. D. shell was demanded.

A designer worked for two days, trying to reconcile the required heat transfer surface with anything like a 24-in. exchanger, without success for various technical reasons. Finally a 19-in O.D. size was settled upon, a very short unit consisting considerably more than the opprobrious "peanut-size" design which was the only reasonable alternative. It was some time before the customer's objections were overcome, because a "big" exchanger was wanted, but the 19-in. design finally was accepted.

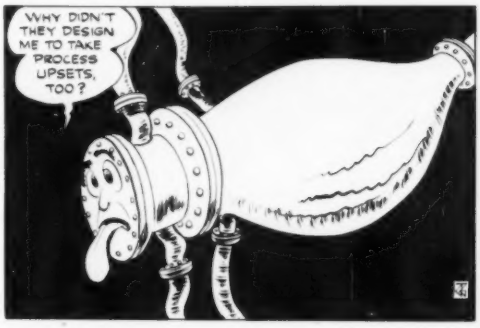
### Common Buyer Failings

A very common failing among buyers is to conceal the possibility or known extent of fouling, especially the presence of entrained solids, scaling and coking potentialities. It is very helpful to have particle sizes as well as anticipated quantities of entrained solids. Maybe fluid velocities can be kept high enough to prevent settling and still avoid erosion difficulties.

The exchanger manufacturer admittedly has been able to save his hide in many instances only because he knew from long and bitter experience, not only by process application but with individual plants, the situations where fouling is apt to occur. If the buyer knows what fouling factors should be used he should specify them.

To avoid the rapid loss of effective surface from fouling in service the manufacturer has only two alternatives which may or may not be used simultaneously. One is to supply an excess of surface over the "clean," or theoretical requirement, by the use of fouling factors determined by experiment and experience. The other is to arrange design to secure high fluid velocities, thereby keeping solids in suspension. Scaling sometimes may be avoided by careful attention to temperature differentials.

The penalty of the first approach is a more expensive exchanger; of the second higher pressure drop but with the added advantage of reduced first cost because of a smaller exchanger. Naturally the manufacturer can-




not accept responsibility for the effects of abnormal fouling and his performance guarantees are based accordingly.

Another common buyer failing, aside from specifying no pressure drop limitation at all until the design calculations are made or even after fabrication has commenced is to go the other way and become too restrictive. The maximum acceptable pressure drop value *never* should be guessed at because is can mean real folding money to the buyer.

In general, the greater the permissible pressure drop, the less expensive will be the exchanger. This develops from the fact heat transfer rates are proportional to fluid velocities at the transfer surfaces, all other variables being constant, because film heat transfer resistances will be reduced. The corollary follows that, the higher the heat transfer rate, the smaller the total transfer surface required for any given heat duty. In practice, this means fewer and smaller tubes and a smaller exchanger with consequent savings in weight of metal and shipping charges.

This effect is quite material when the permissible pressure drop is restricted to 10 psig., or below, for light oil distillates and below 5 psig. for water. In many cases an increase in pump discharge head may be less expensive than exchanger surface.

### Specification Sheet Is Useful

There are many different ways of arranging a list of specifications for heat exchangers, but probably the worst procedure is to prepare them from memory. It is almost certain that something vital will be overlooked.

The best plan is to use a list, wherein every conceivable situation will be covered. While not suggested in the sense that it is deemed the best which can be developed, the specification sheet used by one exchanger manufacturer is shown as an example. The listings have been approved by the Tubular Exchanger Manufacturer's Assn.

On the form is entered as an example the data covering an actual inquiry for a third-stage gas cooler. In black is shown the information which was supplied by the buyer and in color are data which were entered subsequently by the manufacturer after his calculations were completed. Unfortunately space does not permit showing the calculations behind them. Note that in this case most of the physical constants were supplied by the manufacturer because the fluids are well known.

The writer has inspected similar forms customarily used by several engineering contractors. The use of any good standard forms such as these usually are is highly recommended by heat exchanger manufacturers. Some oil companies use them also.

The principal caution suggested in their use, however, is that *all* the spaces on the form need *not* be filled out. A blank space is construed to mean there is no special

restriction or condition to be met beyond that which may be indicated by an applicable code.

Also, it should be remembered that these forms, as well as the listing of information required, which follows, are intended to cover all types of industrial heat transfer equipment (except boilers and fired heaters.) Furthermore, in special or unusual problems, still other data may be needed. Such cases are not treated here because they normally require close cooperation between process engineers, engineering contractors and the exchanger manufacturer.

As in buying any other equipment, the buyer's best safeguard is the integrity of the manufacturer.

The following listing is divided into vital information and that which is very desirable but can be omitted. The same information is required for both tube and shell sides. Applications of various types of equipment is beyond the scope of this article.

## Performance data required when ordering heat exchangers

**VITAL INFORMATION:**

1. Type of service—heat exchanger, condenser or reboiler.
2. Names of the fluids. (May be omitted if *all* physical characteristics are supplied—see Item 4, below.)
3. Quantities of fluids entering. (Preferably in lbs./hr. May be expressed in gpm. or cfm. at entry conditions or under specified conditions. Be sure to segregate vapors from liquids and condensable from non-condensable vapors. Steam, if also present, should be shown separately from other vapors.)
4. Specify quantity to be heated, cooled, vaporized or condensed for at least *one* of the fluids.
5. Physical constants of both fluids: (If a well-known material is named, specific or API gravity is sufficient; if appreciably viscous under service conditions state viscosity at two temperatures, specifying units used. If fluids are not identified, supply additional information below.)
   a. Liquids:
      1) Specific gravity or density at stated conditions.
      2) Specific heat, Btu./lb., at two temperatures (or supply curve).
      3) Viscosity at two temperatures (state units).
   b. Vapors:
      1) Molecular weight.
      2) Latent heat, Btu./lb., at two or more specified pressures.
6. Service conditions:
   a. Temperature:
      1) Inlet—both fluids.
      2) Outlet—at least one fluid, both if known.
   b. Pressure:
      1) Operating pressure, both fluids.
      2) Design pressure.
      3) Pressure drop, maximum tolerance, both fluids. (Do not guess.)
   c. Heat duty. (Specify for reboilers only.)

**DESIRABLE SUPPLEMENTARY INFORMATION:**

1. Presence of solids. (Quantity; nature and particle size if known.)
2. Fluid velocities of dirty liquids. (If known. Aids in avoiding settling or erosion difficulties.)
3. Scale or coke-forming tendencies. (State critical velocities or residence times if known.)
4. Maximum temperatures and pressures under emergency conditions.
5. Are fluids corrosive and what materials are resistant?
6. Fouling factors—both fluids. (If known. Do not guess.)

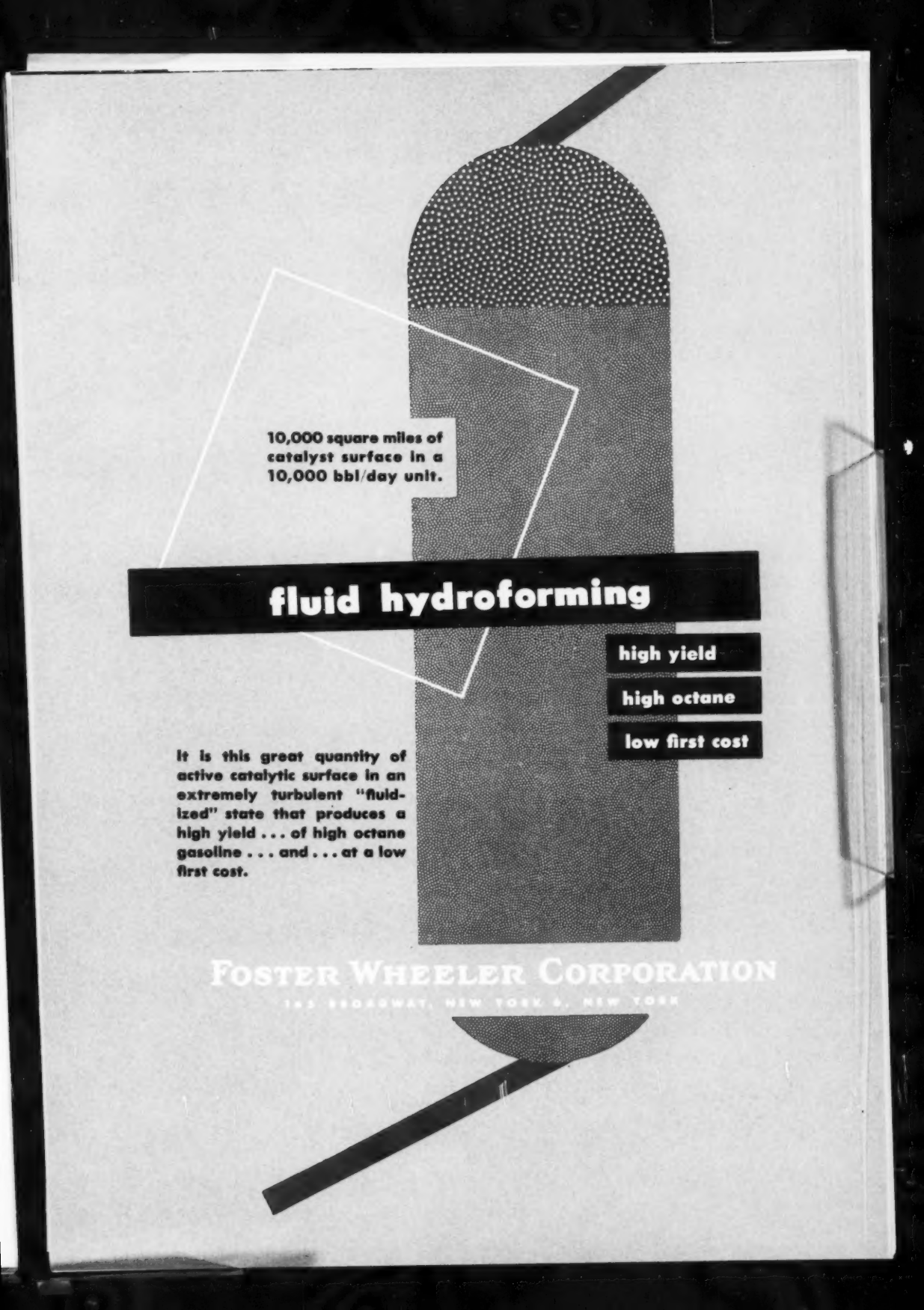
## Construction data required when ordering heat exchangers

**VITAL INFORMATION:**

1. Materials: (Note some items listed are not applicable to all types of heat exchange equipment.)
   a. Shell and cover. (Usually steel.)
   b. Tubes, tube sheets, channel, floating heat and channel cover. (Advise if cladding and bimetallic tubing required; specify.)
   c. Gaskets. (Never specify except for special conditions, usually corrosion.)
   d. Corrosion allowance, shell and tube sides.
2. Code. (Specify solely for buyer's protection. Always advise if code stamp required. Specifying "TEMA Standard" will take care of mechanical details and assure meeting API-ASME Code for unfired pressure vessels. Class "R" applies to oil industry; Class "C" for general process. Always specify class.)
3. Connections—shell and channel (or tube headers). Size inlet and outlet. Flange series and drilling. (Omit if specification prepared for quotation only except advise particulars for special connections. Furnish details of size, etc., when piping design completed if for construction.)
4. Tube bundle construction:
   a. Specify removable or non-removable. (Specify floating or fixed and U-tube types only when known to be necessary.)
   b. Pitch. (Manufacturer usually will design for triangular pitch. Specify square pitch only when manual cleaning will be required. If "TEMA STANDARD" required, state width of cleaning lane only when more than ¼-in. is necessary. Square pitch and extra-wide cleaning lane both will add materially to exchanger cost.)
   c. Outside diameter and gage of tubing. (If buyer has a "plant standard" for inventory control purposes.)
   d. Length of tube bundle. (Specify maximum permissible length only when installation and maintenance space is at a premium. Allow manufacturer to use longest standard tube lengths available.)

**DESIRABLE SUPPLEMENTARY INFORMATION:**

1. Design temperature. (Generally specified only for safety reasons.)
2. Test pressure. (Specify only if exception is taken from any code requirement.)
3. Fin material, if different from tubes. (Consider possibilities of electrolytic corrosion.)
4. If air-cooled exchanger specify:
   a. Type fan drive desired. (State who is to supply and mount driver.)
   b. Power supply characteristics available.
   c. Proposed location of unit with respect to surroundings. (Drawing preferred. Show direction prevailing wind.)


10,000 square miles of catalyst surface in a 10,000 bbl/day unit.
fluid hydroforming
high yield
high octane
low first cost
It is this great quantity of active catalytic surface in an extremely turbulent "fluidized" state that produces a high yield . . . of high octane gasoline . . . and . . . at a low first cost.
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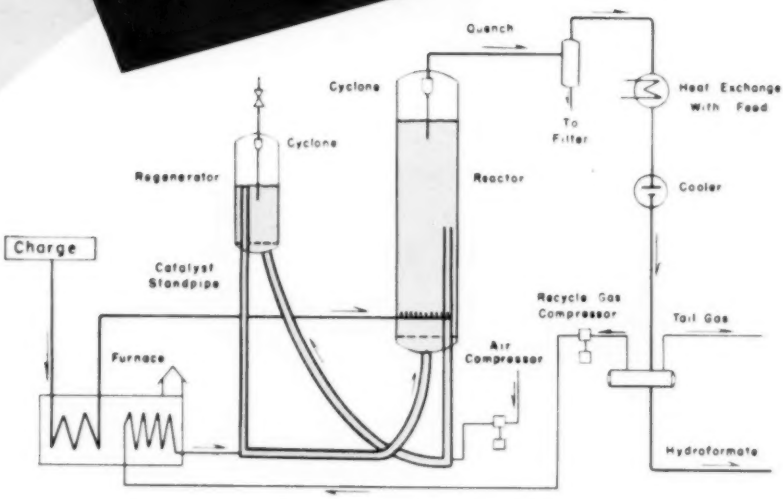
# fluid hydroforming




**The "fluid" principle, as applied to hydroforming, provides all the distinct advantages of full, continuous operation. Its inherent process variables also makes possible a more exact control of the intensity of the hydroforming reaction.**

**Foster Wheeler's Fluid Hydroforming Pilot Plant is available for stock evaluation and determination of process design data.**

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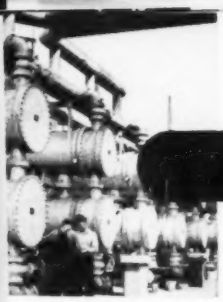

**PLANT PRACTICES**

**Practical Tips and Ideas for Improving Operations**

# Catalyst Sampler Idea Wins $1500

## Employe given large cash award for suggesting simple improvement for checking on TCC regenerator

**Catalyst sampler for TCC unit** regenerator with its inventor, General Petroleum's stillman Howard Hannon

ESTIMATED annual savings of thousands of dollars (the company prefers not to say exactly how much) as the result of a simple, "home-engineered," catalyst sampling device for a Thermofor catalytic cracking unit at General Petroleum Corp.'s Torrance, Calif., refinery provided stillman Howard H. Hannon with an award of $1500 for his suggestion.

In the operation of a TCC unit, controlling the catalyst regeneration has always been a particularly difficult task. Samples must be taken regularly to see that the catalyst is sufficiently restored, and to make sure that it has not undergone excessive attrition and become too finely powdered.

Formerly, to obtain a sample it was necessary to stop the elevator in which catalyst is returned to the top of the unit and the reactor. Since the temperature inside is about 900° F. and the catalyst is moving very fast, taking the sample was quite a trick manually and in addition was tough on the elevator unit. Frequent spills of catalyst brought about expensive by-passing of the unit for cleaning.

Mr. Hannon's device (shown in the accompanying pictures) simplifies the taking of catalyst samples The device is lowered through an access door into the catalyst elevator hopper (below the regenerator). Catalyst falling into the hopper fills the bucket on the sampling device in one or two seconds, and then the sampler is quickly withdrawn. The access door, which is just big enough to allow passage of the device, is then closed.

No particular skill or manual dexterity is required. The operation is safe and quick. The operation of the elevator is not interrupted. Therefore wear and tear caused by restarting the elevator under load conditions is eliminated. Since the new sampling method does not involve entering the elevator shaft, there is no catalyst spilled inside and no need for shutting down the unit while the shaft is cleaned out, as was the case before.

The company states that an aver-

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**Catalyst sampler** is handed down from platform on which it is used to Hannon as General Petroleum's president R. L. Mickler looks on

age of about 26 hours production time had been lost from troubles arising from the previous methods of catalyst sampling. As summarized, the benefits from Mr. Hannon's sampler are as follows:

1. It is no longer necessary to shut down the reactor elevator to obtain a spot bucket sample, with the resultant possibility of a catalyst holdup on re-establishing circulation.

2. Loss of on-stream time due to difficulties in restarting the elevator with a full load have been eliminated.

3. Wear on knuckles of elevator chain due to spinning of the traction rim when attempting to start under full load, as well as overloading the electric drive motor under those conditions, have been eliminated.

4. A more representative sample can be obtained now than heretofore, because instead of a spot sample a composite of several samples over a 24-hr. period can be taken with no danger of operational difficulties.

Even if there had been no tangible dollar saving involved, General Petroleum states that it would certainly have adopted Mr. Hannon's suggestion, purely because of the effect it has in making the TCC unit operators' jobs easier.

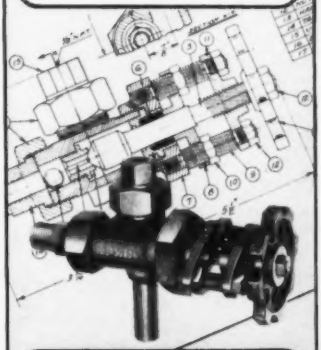
## How to Stop Asphalt Pump Wear

A BAD wear problem on rotary gear pumps in hot asphalt service at Ohio Oil Co.'s Robinson, Ill., refinery has been solved by replacing one of the four roller bearings in each pump with a thrust bearing to eliminate lateral, or axial shift.

In this particular installation, Ohio Oil has a pair of Worthington rotary herringbone gear pumps for transferring finished product from the continuous asphalt oxidizer units to storage. The hot asphalt runs at about 600° F. Soon after the pumps went into service, it was found that severe wear occurred at the ends of both the drive and the driven gears. Within a week to 10 days, there was a clearance of about $\frac{1}{4}$-in. between the gear ends and the side plates on the pump casing. This caused considerable reduction in pumping efficiency.

Several methods were tried at first, including insertion first of a steel spacer plate, and then a piece of Micarta, between the gear end and the


**BEST FOR HIGH TEMPERATURE AND CORROSIVE SERVICES**



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*Eliminate Stem Freezing*

YOU'LL be sure of dependable performance under high temperature or corrosive service conditions when you use rugged Jerguson Outside Screw and Yoke Valves.

These Jerguson OS&Y Valves are made to withstand severe service, and are the ideal answer for high temperature and corrosive services where inside threads cannot be tolerated. Jerguson's efficient outside thread design allows the valve stem to work freely at all times, and forestalls possible freezing.

Jerguson OS&Y Valves are available in any alloy in order to better handle corrosive media; can be repacked under pressure; have renewable and regrindable seats; and are available with Teflon or other special packing. Outlets may be on center line of valve, or offset 7/8". *The Jerguson OS&Y feature may be added to existing installations of Jerguson #50 or #60 Valves.*

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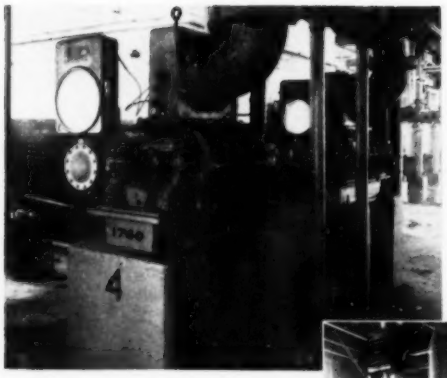
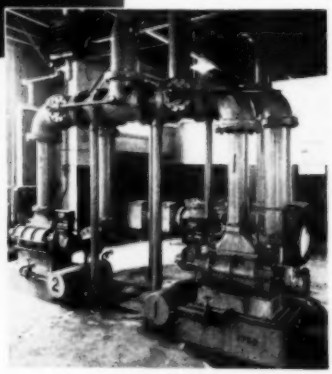
(*To obtain more data on advertised products see page* 1164)



The four meters illustrated are part of a total installation of nine R-C Meters in a large processing plant. These units measure acetylene gas sold to nearby manufacturers, who also use R-C Meters at the receiving ends. Capacities range from 3,000 cfh to 130,000 cfh.



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If you're measuring gas for production processes, you can't take any chances on quantities. If you are buying or selling it, you need cash register accuracy. You want equal precision for departmental cost accounting.

The permanent accuracy of R-C Positive Displacement Meters has long been proved for all these purposes by manufacturers and utilities which buy, sell and use gas. Four important reasons account for this unvarying reliability:

1. Accuracy is not affected by variations in specific gravity, rate of flow, pulsation, moisture, impurities or uncontrollable factors.
2. Accuracy is not subject to adjustment of meter or recorder by operators or other persons.
3. Accuracy is not affected by reasonable overloads.
4. Accuracy is permanent because measuring chambers are surrounded by precision-machined, cast-iron surfaces.

The 31 standard sizes of R-C Meters give capacities from 1,000 cfh to 1,000,000 cfh. They are extremely compact, permitting installation in cramped spaces. Indicating and recording instruments are available for all types. For whatever purposes you measure gas, you can permanently depend on R-C Meters. Ask for Bulletin 10-B-14 or write us your specific problem.

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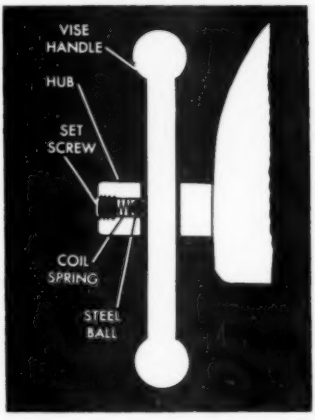
pump wall. Neither method succeeded; the Micarta burned out, for example, in 10 to 12 hours. The final successful solution was to replace the Hyatt roller bearing on the outboard side of the drive shaft with a Timken thrust bearing. In order to accomplish that, the shaft was machined down to fit and end bushings were installed to accommodate the shorter bearing.

The pumps have now been operating satisfactorily for 7 to 8 months with no further sign of wear. They run almost continuously; the cycle being 3 to 5 weeks on and 2 days off. In addition, there has been no further leakage at the stuffing boxes. It was necessary to replace only one of the roller bearings. The others show no further axial shift since the herringbone gears tend to keep the two shafts in alignment.

## Vise Handle Stays Put, Saves Finger Injuries




By ROBERT L. PATTON*

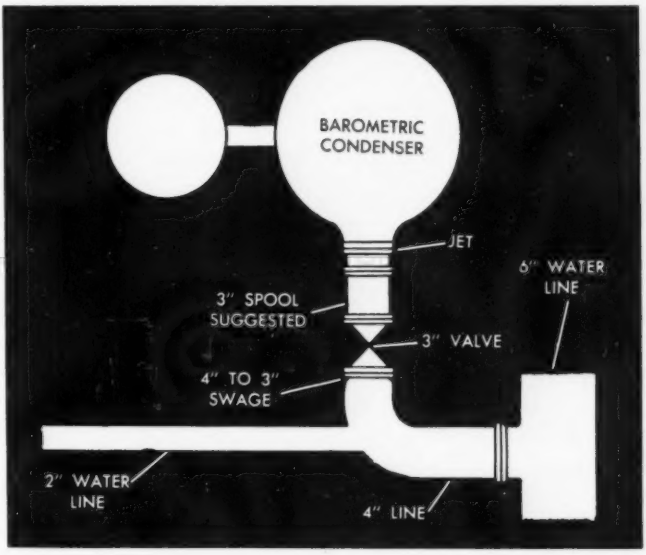
A NEVER-ENDING source of exquisite pain, known to anybody who has worked much around a shop, is having a bench vise handle slip down and pinch the fingers. We thought it would be handy, and incidentally, save a lot of pinched fingers, if our vise handle would stay in any desired position, regardless of the angle of inclination.

To lick the problem, we drilled a hole in the hub of the vise shaft (see sketch), and inserted a steel ball, a coil spring, and a set screw. Now, our vise handle slides end-for-end at a touch. Yet it will stay out at any angle, even in a vertical, upside-down position. It never drops unexpectedly on a hand resting on the vise hub.

* Mr. Patton is Instrument Foreman, Gulf Refining Co., Cleves refinery, Cincinnati, Ohio.

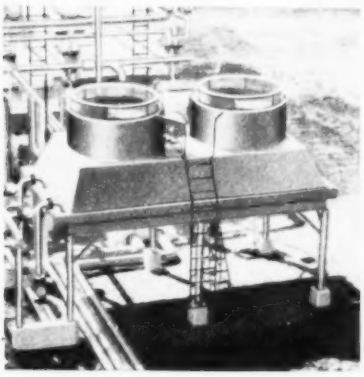
# Fast Clean-out for Barometric Jet

THE job of cleaning out a barometric condenser at Socony-Vacuum Oil Co.'s Atlas refinery in Buffalo, N. Y., has been made a great deal easier by the method shown in the accompanying sketch. Before this arrangement was adopted, it had been necessary to shut down the water system from the unit before the jet could be cleaned, because the 3-in. valve had to be taken out. Now, it is necessary only to close the 3-in. valve and then drop out the 3-in. spool piece. A workman can then reach in and clean the jet.




### Correction

The brief item in Plant Practices in the August PETROLEUM PROCESSING, page 881, entitled "Fast Size Adjustment on Can Filler", was credited to the suggestion by Paul L. Jessup, Socony-Vacuum Oil Co., Paulsboro, N. J. It should have been credited to R. C. Wunschel, also of the Paulsboro refinery.

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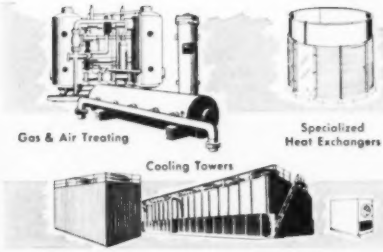


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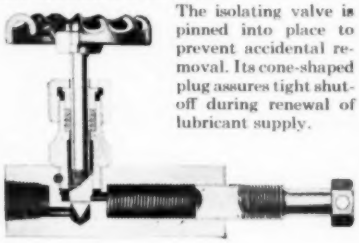

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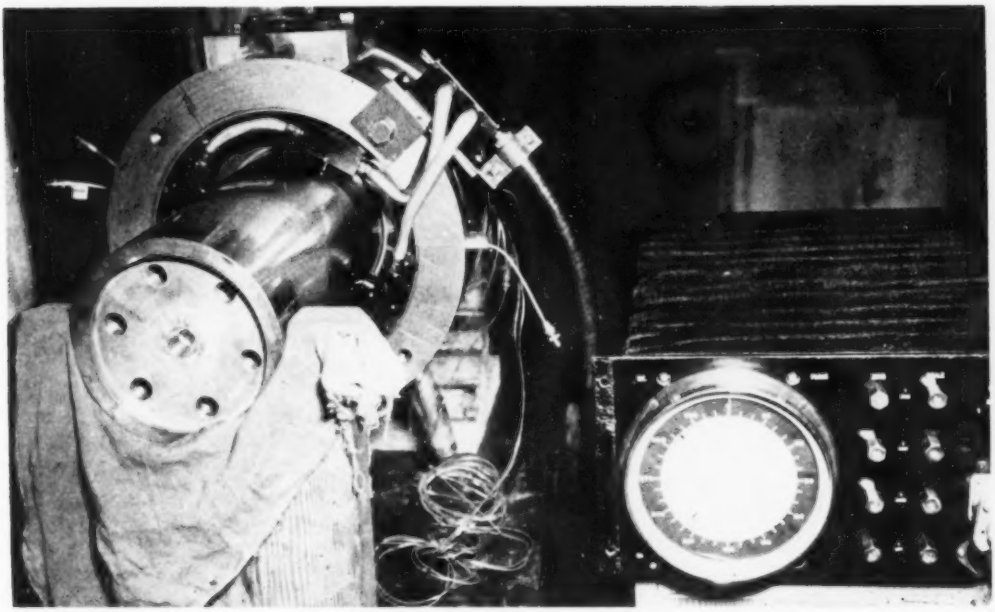


**Oil film thickness indicator,** Model 1, developed by Standards Bureau, and installed on a test sleeve-type bearing

# Oil Film Thickness Indicators

## Sensitivity of 0.00001 inch obtained with mutual-inductance type of electrical measuring element

IN STUDIES of engine lubricants and engines, it is often desirable to measure clearances between shafts and sleeve- or journal-type bearings during operation. However, it is usually rather difficult to obtain such measurements without affecting the operation, particularly at high speeds.

A method developed recently by M. L. Greenough and associates of the National Bureau of Standards for the Navy Bureau of Ships appears to offer a satisfactory solution to the problem. The heart of the system is a mutual-inductance type of electrical distance-measuring element: variation of the distance of the rotating shaft from two small fixed coils results in a readily measurable variation in the coupling between the coils.

Development of this new gage centered around the problem of measuring film thickness in a 6-in. bearing with a radial clearance (difference in radius of shaft and bearing) of about 0.006 in. Anticipated maximum rotational speeds were in excess of 10,000 rpm.; hence, the gage was designed to make no physical contact with the shaft. Operation in lubricating oil at a temperature of 200° F. was another requirement.

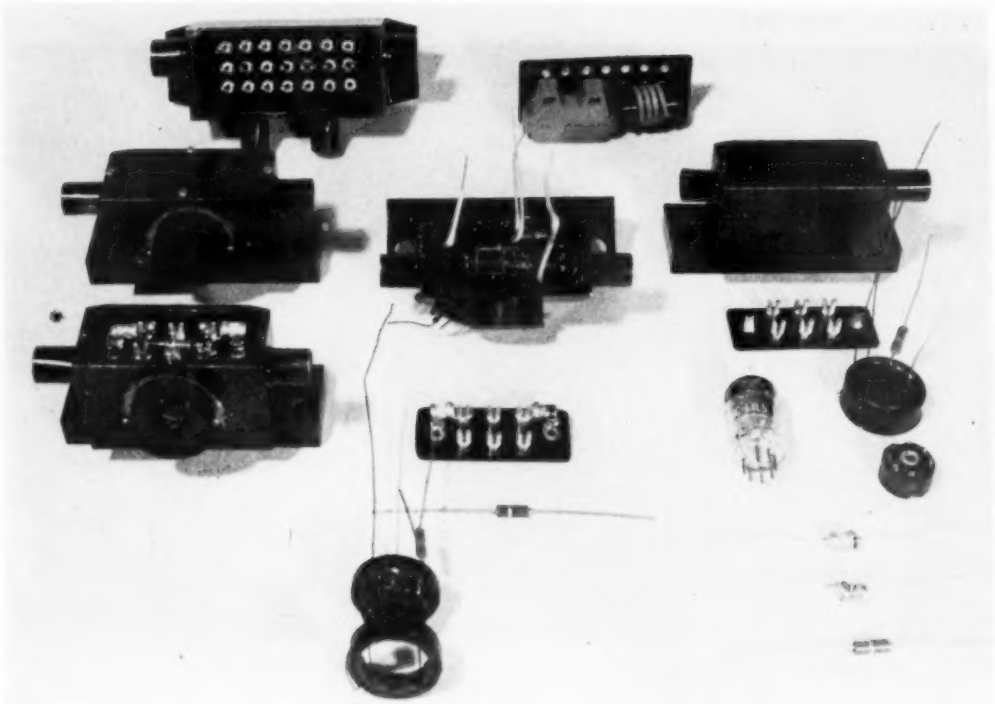
Three successful variations of the device have been developed. The models differ in the type and number of probes used, in sensitivity, in suitability for measuring vibratory conditions, and in type of indicating device. A cathode-ray tube is used with one model to provide a continuous picture of shaft displacement, while the other models give distance indications on a dial or meter. Sensitivity is ample; a distance change of as little as 0.00001 in. (10 microinches) — less than a thousandth of the difference in diameter between shaft and bearing — may be detected. In the cathode-ray tube model, a small displacement of the shaft causes a displacement 150 times as great in the face of the cathode-ray tube, and this is by no means the maximum magnification attainable with the system.

In general, measurement of the distance of the shaft from a single probe will not define the shaft-to-bearing distance at all points, even though the shaft be perfectly rigid. From two to six probes are therefore used in the various models. The probes are fastened rigidly to the bearing under study at various locations just outside the point at which the shaft enters the bearing.

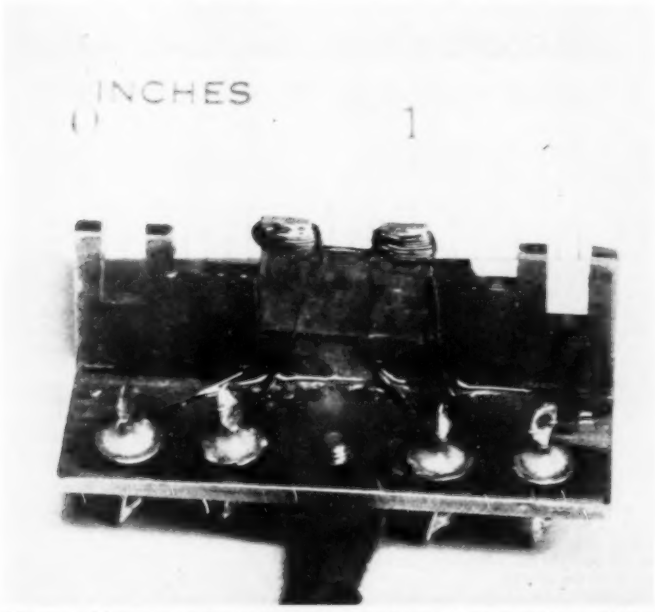
### Air-core Probes in One Type

Air-core probes at radio-frequency are used in one style (Model 1), while iron-core probes at audio frequency are used with the others (Models 3 and 4). Although the air-core probe system was developed originally at the Bureau for oil film thickness measurements, the same principle has been used in the Bureau's electronic micrometer[1] and micromanometer[2][3]. The miniature iron-core type, however, is an outgrowth of work of previous investigators of oil film thickness.

Both types of probes have much in common. Each consists of a pair of small coils—a primary and a secondary—mounted close to each other and close to, but not touching, the surface of the shaft. An alternating current



**Details of air-core probe** assemblies. Probe proper (foreground) is mounted in a steel block, from which it projects (several stages of assembly at left). Inside block are rectifiers, resistors, and capacitors (right foreground)




**Close-up of iron-core probe.** Primary and secondary coils are wound around legs of a U-shaped form

applied to the primary induces in the secondary a voltage dependent upon the mutual inductance or coupling between the coils. Because of the effect of the nearby metal shaft on the electrical field of the coils; the coupling, and hence the output voltage, varies with changes in shaft-to-coil distance. The readily-measurable relation between primary current and secondary voltage is thus an index of shaft-to-coil distance, and indicating instruments may be calibrated in terms of shaft-to-bearing distance.

In the air-core probes, which operate at a frequency of the order of 2.5 megacycles, the coils are concentric and approximately coplanar. The nearby metal shaft acts as a shield; the closer the shaft to the probe, the less the coupling between the coils.

The coils of the iron-core probes, which are operated at about 2000 cycles, are wound on the legs of a U-shaped form. The nearby steel shaft increases the magnetic flux through the coils; thus, with the iron-core probes, the closer the shaft to the probe the greater the coupling between the coils.

Each of the two types of probe has its advantages and limitations. The iron-core technique is better suited to installations where maximum sensitivity is desired and, fur-

thermore, does not require copper plating of the steel shaft. The rf. air-core probes, on the other hand, make possible accurate observations at high-frequency shaft vibration; these are not possible with the low-frequency iron-core method. The air-core system is also more nearly linear: the input-output ratio is more closely proportional to the distance.

Model 1, the air-core unit, is used with a cathode-ray tube to give a polar diagram of the displacement of the center of the shaft from the center of the bearing. This is accomplished by means of four probes spaced at 90-degree intervals and supplied with constant current. The rectified output of each probe is connected to a corresponding one of the four deflection elements, similarly arranged in quadrature, of the cathode-ray tube.

The position of the electron beam at any instant is thus the resultant of the four rectified probe output voltages. When the shaft is exactly centered, the electron beam (necessary calibration factors having been introduced electrically) is also exactly centered. When the shaft is displaced from center, both the direction and the amplitude of this displacement are depicted on the face of the tube.

### Iron-Core Models

Models 3 and 4—the iron-core models—are used with voltmeters rather than cathode-ray tubes. More sensitive than Model 1, both are well suited to precise distance measurements in a bearing test installation after Model 1 has provided an over-all picture.

In Model 3, which uses two probes, the 2000-cycle primary input is automatically adjusted to the level required to give a constant secondary output. The adjusted input is indicated on a meter calibrated in distance units.

Six probes are used with Model 4, which is even more sensitive than Model 3. In this model, primary current is held constant while secondary voltage is measured with a bridge circuit of adjustable sensitivity. The bridge circuit is balanced by adjusting a potentiometer dial having an approximately linear scale calibrated in distance units. Model 4, which also uses fewer tubes (three instead of seven or eight) and is probably the most reliable and accurate of the series, is the culmination of the present NBS-BuShips oil-film thickness measurement program.

### References


(1) "Shielding Principle Provides Electronic Micrometer," *NBS Tech. Bull.*, Vol. 31, No. 37 (1947).

(2) "Diaphragm-type Micromanometer with Electronic Pickup," *NBS Tech. Bull.*, Vol. 34, No. 137 (1950).

(3) "Mass Spectrometer Analyses More Accurate with Sensitive Electronic Micromanometer," PETROLEUM PROCESSING, Dec., 1950, pp. 1329-1330.



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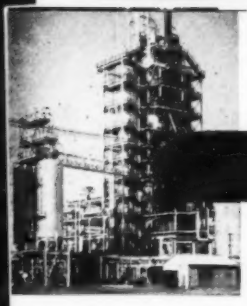

# PROCESSING PATENTS

**New Developments in Processes and Products**

*By PETER J. GAYLOR, Patent Attorney*
*Gaylor, Cifelli & Jurick, Newark, N. J.*

## Combination Acid-Clay Treating Method Improves Quality of Fuel Oils

THE problem of eliminating screen clogging tendency, odor, storage instability, etc. in fuel oils is a serious one. The conventional treating method involves agitation with sulfuric acid, followed by neutralization of the separated sour oil phase with aqueous alkali.

According to Shell Development Co.'s U. S. Patent 2,563,369, an improved fuel oil can be prepared by a process including a proper combination of a controlled sulfuric acid treat, separation of the oil phase from acid phase, followed by a first clay treat, coordinated with the acid treat, and with one or more subsequent clay treats of the separated oil phase at selected temperatures and with simultaneous gaseous blowing in presence of the clay.

The amount of clay needed for removal of sludge material remaining dispersed and/or solubilized in the acid treated oil phase and for the subsequent clay treatments increases with amount of acid used in the acid treatment. Furthermore, the amount of clay utilized in the first clay treatment following the acid treatment is critical. Most of the color improvement and sludge acid removal takes place in the first stage. Therefore, sufficient clay must be added to insure a low neutralization number of the oil leaving the separator following the first clay treatment. But nothing more is to be gained by utilizing a large excess of clay in this first clay treatment since it does not reduce the clay requirements of the subsequent treatment(s), and economically it is undesirable.

The proportion of acid utilized in the acid treatment ranges, in general, from about 1 to 4 lbs. of about 87-95% sulfuric acid per barrel of fuel oil. However, depending on the exact nature of the oil, there is an optimum ratio of acid to oil for a given set of contacting conditions. Thus, it has been found that for treatments at normal ambient atmospheric conditions the following ratios are optimum for three different refinery gas oil stocks: $1\frac{1}{2}$ to 2 lbs. $H_2SO_4$ per bbl. of thermally cracked stock; 3 to $3\frac{1}{2}$ lbs. per bbl. of catalytically cracked stock; and 1 lb. per bbl. of heavy sour straight run gas oil.

The first clay treatment should be effected at ambient atmospheric temperatures. However, it is advantageous and sometimes necessary to effect the subsequent clay treatment(s), preferably two, at an elevated temperature. The temperature may be as high as about 180° F., and preferably should be up to 160° F., in the subsequent treating stages if the oil has been treated with the optimum amount of acid. When an excess of acid is utilized temperatures even as low as 130° F. have been found to be harmful unless very large quantities of clay were added.

The clay treatments are advantageously carried out by a combination of consecutive mixing and separating steps, the final oil-clay separation (settling and decantation) being followed by a dry filtering operation of separated oil phase. In a preferred embodiment a charge of the acid-treated oil is mechanically agitated for about 15 to 30 min. with the first clay charge, the mixture passed to a settler from which settled clay is withdrawn and sent to waste or a recovery system while decanted oil is passed to a second stage mixer. The oil is then mechanically agitated with a second clay charge while simultaneously blowing with an inert gas ($N_2$, $CO_2$, etc), alone or mixed with oxygen, air being a preferred gaseous mixture, for about 15 to 30 min. at 120-135° F. The blowing serves to effect coagulation of colloidal particles, which are removed by the absorbent clay, while at the same time removing excess $SO_2$. The oil is then separated from the clay in a second settler, the separated clay being charged to the first treating operation while the oil (if desired) is charged to a third mixer where another clay-air treatment is carried out similar to the second clay treating, except at a higher temperature. Recovered clay from this third step may be used in the second step. The treated oil then is filtered to remove any remaining suspended clay particles.

The neutralization numbers of the clay treated product are higher in each case than those of the aqueous caustic treated product, which, of course, was thoroughly water washed to remove any excess alkali. It is not known if this represents organic acids present in the acid-treated product which are not removed by the clay treatment, but are removed by caustic neutralization, or if it represents organic acids formed in the oil as a result of the air blowing of the neutralized oil in the presence of the clay in the subsequent clay treatments, and which acids are not simultaneously adsorbed and removed by the clay.

However, there is evidence which indicates that the first possibility accounts, at least in part, for the higher acidity. The use of more acid in the acid treatment appears to remove these organic acids and give a lower neutralization number, but over-acid treatment increases the potential corrosivity of the finished product. In this connection, it has been found that aqueous caustic more completely removes sulfur dioxide from the oil than does clay neutralization, but that the air blowing in the presence of the clay effectively removes the sulfur dioxide. Therefore, the higher acidity of the clay-air treated product than the aqueous caustic treated product is not attributable to a difference in the removal of sulfur dioxide.

Another advantage claimed over the aqueous caustic treatment is the avoidance of introducing water into the oil, which is believed to contribute, at least in part, to the tendency of the usual fuel oils to result in the clogging of screens in burner installation fuel oil lines.

## Wear Preventives in Fuels

RECENTLY, there has been considerable activity in the use of volatile corrosion inhibitors in wrapping paper used for metal articles. Shell Oil Co. is marketing VPI for this purpose. A patent just issued to Shell Development Co. discloses advantageous use of such volatile corrosion inhibitors for preventing wear in moving engine parts. This is done preferably by incorporating at least about 0.001% of such inhibitor in the fuel.

In one example, the use of morpholine nitrite in gasoline (0.1 mg per 100 ml) is reported to have reduced piston ring wear by 20% in a 20 hr. test period. Placing solid morpholine nitrite in the air cleaner of a Diesel engine, so that the vapors could be sucked into the combustion space by the air, is claimed to have shown a decrease in piston ring wear of 17%. It is specified that the inhibitor should

have a vapor pressure of at least 0.00002 mm. Hg at 21° C. Suitable compounds are diisopropyl amine nitrite, dicyclohexylamine nitrite, morpholine nitrite, etc. (U. S. Patent 2,563,764).

## Fluosulfonic Acid Promotes Sulfuric Acid Isomerization

THE isomerization of branched paraffins is an important process from the aviation fuel point of view. For example, conversion of 2,4-dimethylpentane having an ASTM clear octane of 83.6 to 2,3-dimethylpentane of 89 clear octane, boosts the F-4 (rich mixture) rating from 83 to 143.

Sanderson[1] has patented this conversion process in presence of 95-97% sulfuric acid, while Birch and others[2] specified 97% sulfuric acid treatment. Also, Caesar and Francis[3] employed 97% sulfuric acid for this isomerization reaction. As can be seen from the lower curve in Fig. 1, the isomerization reaction of 3-methylpentane is fastest in sulfuric acid of about 99.7% or 99.8%.

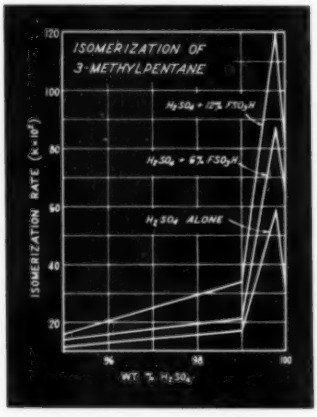


**Fig. 1—Effect of additions** of fluosulfonic acid on isomerizing rate of strong sulfuric acid. (Indiana Standard—U. S. 2,564,080)

Halogen sulfuric acids, such as fluosulfonic acid, have been described as isomerization catalysts[4] for paraffin hydrocarbons. However, such acids, and particularly fluosulfonic acid, also act as cracking catalysts, so that low temepratures[2] or hydrogen[4] must be used to minimize the cracking reaction.

Workers at Standard Oil Co. (Ind.)[3] find that the isomerization property of sulfuric acid can be augmented significantly, without excessive cracking, by the addition of relatively small amounts of fluosulfonic acid. As shown in Fig. 1, addition of this acid promoter increases the isomerization rate until, at 12% fluosulfonic acid concentration, the rate is almost tripled. Beyond 12%, the velocity begins to drop. Reaction temperature is at 15° C. to 50° C.

In order to obtain emulsification of the acid with the hydrocarbon, 0.5% to 1% of stearic acid is added. After reaction, the acid is separated either by water dilution or centrifugation.

**References**

(1) Sanderson, U. S. Patent No. 2,404,661.
(2) Birch et al, U. S. Patent No. 2,373,740.
(3) Caesar and Francis, *Ind. Engrg. Chem.* 33, 1426 (1941).
(4) U. S. Patents 2,344,889-90.
(5) Roebuck et al, U. S. Patent No. 2,564,080.

## Patents Issued in August

*The following classified listing gives the patent number, patentee or assignee, and a brief description of all patents believed to be of interest to the petroleum processing industries, as contained in the Official Gazettes of the U. S. Patent Office for August 7, 14, 21 and 28, Vol. 649, Nos 1-4.*

### Fuels

2,562,885 (California Research Corp.) Thallous compounds as rich mixture fuel additives.
2,562,980 (The Texas Co.) Upgrading F-T Diesel Fuel.
2,563,051 (Universal Oil Products Co.) Motor fuel and drying oil by hydrogen fluoride polymerization and alkylation.
2,563,265 (Aerojet Engineering Corp.) Rocket motor with solid asphalt-oil propellant.
2,563,369 (Shell Development Co.) Refining fuel oil.
2,563,532 (U. S. A.) Spontaneous ignition of gasoline and nitric acid.
2,563,543 (Phillips Petroleum Co.) Controlling British thermal unit value of gas.
2,563,764 (Shell Development Co.) Prevention of corrosive wear of moving metal parts with organic nitrite.
2,564,501 (Rieke) Liquid terphenyl burning fuel.
2,564,791 (Phillips Petroleum Co.) Method for maintaining heating value of a fuel gas.

### Catalysts

2,562,888 (Houdry Process Corp.) Preparation of silica-metal oxide granular catalyst.
2,563,686 (Shell Development Co.) Segregating powdered materials into fractions of different particle size.
2,563,977 (Filtrol Corp.) Process for continuously acid activating clay.
2,564,331 (The Proctor & Gamble Co.) Preparation of a coprecipitated nickel-zirconium catalyst.
2,564,776 (Socony-Vacuum Oil Co.) Extrusion of a frozen and thawed hydrogel.
2,565,627 (The Davison Chemical Corp.) Coprecipitated silica-magnesia gel.

### Conversions

2,562,903 (Houdry Process Corp.) Catalytic cracking apparatus.
2,562,926 (Phillips Petroleum Co.) Isomerization of hydrocarbons.
2,562,989 (The Texas Co.) Upgrading olefinic stocks by isomerization and hydrogenation.
2,562,993 (The Texas Co.) Apparatus for effecting catalytic reactions.
2,563,051 (Universal Oil Products Co.) Motor fuel and drying oil by hydrogen fluoride polymerization and alkylation.
2,564,072 (Standard Oil Co.—Indiana) Aromatic alkylation process.
2,564,077 (Standard Oil Co.—Indiana) Aromatic alkenylation process.
2,564,080 (Standard Oil Co.—Indiana) Isomerization of saturated hydrocarbons with mixed acid catalysts.
2,564,268 (Phillips Petroleum Co.) Catalytic oil cracking.
2,564,278 (Phillips Petroleum Co.) Selective conversion of alkyne hydrocarbons.
2,564,388 (Shell Development Co.) Isomerization of xylenes.
2,564,488 (Phillips Petroleum Co.) Alkylation of toluene by propylene catalyzed by acid activated montmorillonite clay.
2,564,964 (Phillips Petroleum Co.) Saturated hydrocarbons from olefins by use of cis decalin as hydrogen donor.
2,565,498 (Houdry Process Corp.) Hydrocarbon conversion.
2,565,886 (Shell Development Co.) Silica-alumina cracking catalyst.
2,566,285 (Socony-Vacuum Oil Co.) Regeneration of moving catalysts.

### Lubricants

2,562,904 (Freeman) P-S Lubricating oil composition.
2,563,013 (Celanese Corp. of America) Fatty lubricating compositions.
2,563,588 (Standard Oil Development Co.) Soluble cutting oils.
2,563,606 (Standard Oil Development Co.) Grease containing silica gel treated with a polyhydric alcohol.
2,563,609 (Standard Oil Development Co.) Lubricating oil pentaerythritol additives.
2,564,561 (Socony-Vacuum Oil Co., Inc.) Barium grease composition.
2,564,634 (Socony-Vacuum Oil Co., Inc.) Lubricant containing hydroabietyl esters.
2,565,938 (The Ironsides Co.) Lubricant metal-rolling composition.
2,565,981 (Standard Oil Development Co.) Lubricating grease.
2,566,157 (Elgin National Watch Co.) Triple ether lubricant.
2,566,241 (The Standard Oil Co.) Reaction product of phosphorus sulfide-polyolefin-oxygen containing organic compound and mineral oil compositions containing same.
2,566,289 (Cities Service Oil Co.) Lubricants for steam turbines.

### Chemicals

2,562,988 (The Texas Co.) Nitro- and thiocyano-substituted thiophene compounds.
2,562,994 (The Texas Co.) Preparing fluorothiophene.
2,563,007 (Phillips Petroleum Co.) Production of alkali metal salts of N-substituted dithiocarbamic acids.
2,563,037 (Universal Oil Products Co.) Conversion of aromatic amines to aromatic hydrocarbons.
2,563,050 (Universal Oil Products Co.) Treatment of olefins with liquid anhydrous hydrogen bromide.
2,563,051 (Universal Oil Products Co.) Motor fuel and drying oil by hydrogen fluoride polymerization and alkylation.
2,563,073 (Universal Oil Products Co.) Haloalkylation of thiophene.
2,563,074 (Universal Oil Products Co.) Production of spirohydrocarbons.
2,563,085 (Phillips Petroleum Co.) Removing solid polymeric material from process equipment.
2,563,087 (Universal Oil Products Co.) Separation of thiophene by selective alkylation.
2,563,206 (Polymerisable Products Ltd.) Cyclohexane carboxylic acid esters.
2,563,383 (Shell Development Co.) Terminally unsaturated polythio polyethers.
2,563,437 (Allied Chemical & Dye Corp.) Manufacture of sulfur from hydrogen sulfide.
2,563,624 (Standard Oil Development Co.) Cleaning isobutylene polymerization apparatus.
2,563,631 (Standard Oil Development Co.) Preparing liquid copolymers of ethylene and styrene.
2,563,685-6 (Standard Oil Development Co.) Regeneration of olefins from acid solutions.
2,563,729 (Cities Service Oil Co.) Solvent extraction of organic acids.
2,563,771 (Shell Development Co.) Carbonates of unsaturated diols.
2,563,772 (Shell Development Co.) High molecular weight halogen-containing organic materials stabilized with iron salts.
2,563,826 (California Research Corp.) Preparation of aryl dicarboxylic acids.
2,563,826 (California Research Corp.) Process for producing 3,5-dimethyl 1-ethyl benzene.
2,563,997 (California Research Corp.) Styrene-butadiene copolymer and process of preparing same.
2,564,073 (Standard Oil Co.—Ind.) Disproportionation of xylenes.
2,564,104 (E. I. du Pont de Nemours & Co.) Process for reacting olefinic compounds with carbon monoxide and hydrogen.
2,564,194-5 (Shell Development Co.) Stabilization of high molecular weight organic material containing inorganic acid-forming elements.
2,564,200 (Stanolind Oil & Gas Co.) Azeotropic

distillation of alcohols from methyl n-butyl ketone.
2,564,395 (Shell Development Co.) Copolymers of diallyl phthalate and diallyl esters of dimerized unsaturated fatty acids.
2,564,404 (Shell Development Corp.) Crack-resistant rubber and method for producing the same.
2,564,456 (Shell Development Co.) Synthesis of oxygenated compounds.
2,564,632 (Phillips Petroleum Co.) Emulsion polymerization with pentadienes.
2,565,087 (Allied Chemical & Dye Corp.) Process for oxidation of cycloaliphatic compounds.
2,565,195 (The Pure Oil Co.) Process for the preparation of methyl and methylene sulfur compounds.
2,565,215 (The Pure Oil Co.) Preparation of carbon disulfide.
2,565,395 (Standard Oil Development Co.) Hydrogen from hydrocarbon gases.
2,565,398 (Standard Oil Development Co.) Oxidation-resistant high molecular weight pentadiene copolymers.
2,565,428 (California Research Corp.) N-alkyl substituted anilines.
2,565,488 (Shell Development Co.) Secondary 1,3-alkenediamines.
2,565,493 (Sinclair Refining Co.) Sulfurized paraffins.
2,565,529 (Shell Development Co.) Conjugated aldehyde-secondary amine reaction products.
2,565,654 (Universal Oil Products Co.) Vegetable oil-hydrocarbon oil-carbonyl compounds.
2,565,812 (Phillips Petroleum Co.) Production of rubber products.
2,565,969 (Standard Oil Development Co.) Improved hydrocarbon resin.
2,565,998 (Standard Oil Development Co.) Alkyl phenols as stabilizers for synthetic rubber latex.
2,566,037 (Standard Oil Development Co.) Apparatus for analysis by mass spectrometry.
2,566,135-6 (Standard Oil Development Co.) Method of removing acetylenes from diolefin mixtures.
2,566,137 (Standard Oil Development Co.) Removing acetylenes from hydrocarbon mixtures and improvements in the separation of butadiene and acetylenes.
2,566,159 (Sinclair Refining Co.) Effecting chemical reactions with solid catalyst particles.

## Specialties

2,564,199 (Continental Can Co., Inc.) Chlorinated paraffin zinc-containing flux.
2,564,422-3 (Shell Development Co.) Corrosion preventive composition.
2,564,534 (Sun Oil Co.) Polychlorinated vinylcyclohexane and its use as insecticide.
2,564,709 (Phillips Petroleum Co.) Production of carbon black.
2,564,736 (Godfrey L. Cabot, Inc.) Process of producing carbon black.
2,564,833 (Union Oil Co. of California) Carbon black production.
2,565,403 (Standard Oil Development Co.) Textile oils.
2,566,068 (Cities Service Research & Development Co.) Corrosion inhibiting compounds.

## Hydrocarbon Synthesis

2,563,607 (Standard Oil Development Co.) Hydrocarbon synthesis promotor.
2,564,236 (Phillips Petroleum Co.) Recovery of carbon monoxide and hydrogen from high nitrogen content gas.
2,564,696 (Hydrocarbon Research, Inc.) Hydrocarbon synthesis.
2,564,958 (Phillips Petroleum Co.) Fischer-Tropsch process for the synthesis of hydrocarbons.
2,564,985 (Phillips Petroleum Co.) Hydrocarbon synthesis process.
2,565,347 (Imperial Chemical Industries Ltd.) Stabilization of pyrophoric metal catalysts under fluidized conditions.
2,565,977 (Standard Oil Development Co.) Catalysts for conversion of carbon oxides with hydrogen.

## Refining

2,563,344 (Union Oil Co. of Calif.) Azeotropic distillation of hydrocarbons with aqueous azeotrope formers.
2,563,598 (Standard Oil Development Co.) Removal, with iron, of peroxides from hydrocarbons and oxygenated solvents.
2,563,605 (Standard Oil Development Co.) Distillation of acid-treated oils.
2,563,628 (Standard Oil Development Co.) Treatment of olefin-containing aromatic hydrocarbons with acid and alkali.
2,564,071 (Standard Oil Development Co.—Indiana) Refining oils.
2,564,409 (The M. W. Kellogg Co.) Extraction of oleiferous materials.
2,564,532 (Sun Oil Co.) Separation of naphthene hydrocarbons with carbon.
2,564,717 (Sun Oil Co.) Continuous adsorption process.
2,564,911 (Universal Oil Products Co.) Separation process.
2,564,970 (Phillips Petroleum Co.) Liquid-liquid contacting for separating hydrocarbons having different degrees of saturation.
2,565,349 (Standard Oil Development Co.) Sweetening petroleum distillates by air blowing in presence of caustic and pyridine catalyst.
2,565,354 (Standard Oil Development Co.) Removal of organic peroxides with leuco bases.
2,565,489 (Fischer) Dewaxing of mineral and tar oils.

## Miscellaneous

2,562,901 (Fischer) Apparatus for determining paraffin percentages.
2,562,902 (Fischer) Method of testing oil content of wax.
2,562,906 (Sun Oil Co.) Electrical primary cell construction.
2,563,902 (Standard Oil Co.—Indiana) Mixing device.
2,564,394 (Shell Development Co.) Metallic coiled spring with protective cover.
2,564,910 (Universal Oil Products Co.) Process for concentrating hydrofluoric acid.
2,565,345 (Standard Oil Development Co.) Device for spinning pipe.
2,565,355 (Standard Oil Development Co.) Bubble tray and support structure.
2,565,374 (Standard Oil Development Co.) Compounding of reciprocating pumps.


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(To obtain more data on advertised products see page 1164)

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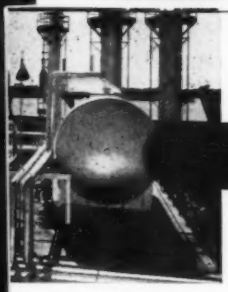




# Catalytic Synthesis Reactor

## Revolving helix provides satisfactory means for maintaining proper catalyst fluidization

A CATALYTIC conversion apparatus, designed for reacting synthesis gas to hydrocarbons, utilizes a rotating helical screw to move the catalyst bed through the vertical reaction zone. Using concurrent flow, the device may also be employed for such other reactions as polymerization and dehydrogenation, it is stated.

An advantage cited for the design is in its ability to maintain the catalyst in a fluidized state within the reaction zone during the conversion, irrespective of the density of the particular catalyst in use and the contraction in vapor as a result of the reaction. For example, in the synthesis gas conversion, substantial contraction in vapor volume occurs. This normally causes some loss in fluidization of a powdered catalyst in more conventional type reactors wherein fluidization is effected by gas flow.

Also with high density catalyst, extremely high rates of gas flow are necessary to effect fluidization in a conventional reactor. Fluidization of dense catalyst particles without the necessity of maintaining undesirably high rates of gas flow is a material advantage with relatively slow conversion reactions which require more contact time.

The operation of the device, which is illustrated in Fig. 1, is given in the following typical example. It is being used in the example for converting CO and $H_2$ into hydrocarbons, oxygenated compounds and the like by contact with a powdered catalyst of the iron type at a temperature range of about 550-650° F. The catalyst may comprise about 94% metallic iron, about 4% alumina, and 0.1 to 2% potassium oxide. Particle size ranges from about 60 to 325 mesh. Reaction may be carried out under pressure of about 150-250 psi.

The synthesis gas, preheated if necessary, is conducted through pipe 40 into the bottom of the vessel 1 (see Fig. 1). Gaseous reactants rise along or through the flights of the rotating helix in the inner jacketed chamber 3 and in contact with the catalyst powder being lifted by the helix. The helix may revolve at from about 100 to 2000 rpm. Reactants may be introduced at sufficient rate to flow through reaction zone 3 at a space velocity ranging from 100 to 5000 cu.ft./cu.ft. reactor space per hr. These latter two variables are so correlated to maintain catalyst in a fluidized state.

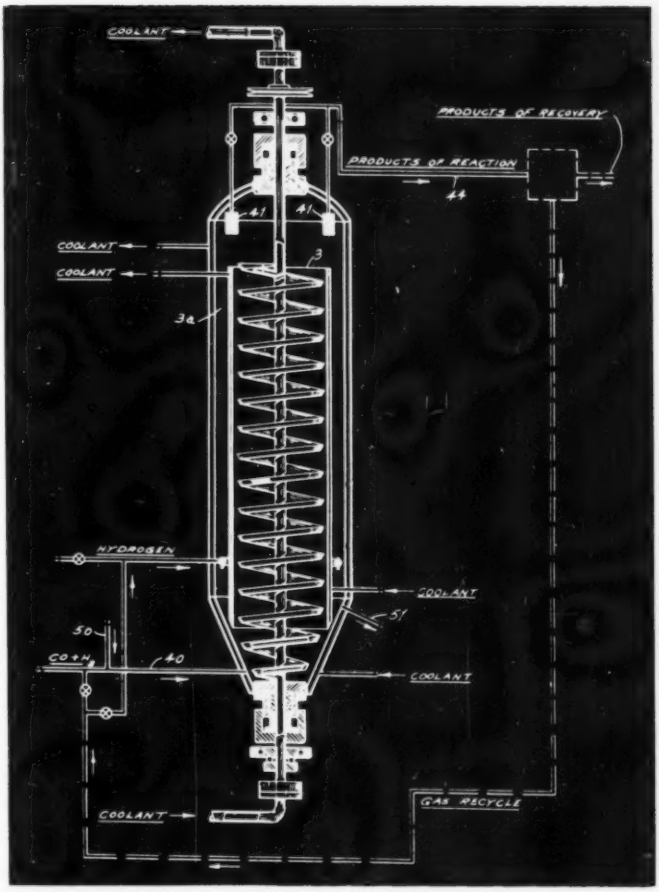



**Fig. 1—"Fluidized moving bed"** is an essential feature of this catalytic conversion apparatus (U. S. 2,562,993)

Unreacted gas, reactor products,

and some entrained catalyst rises to the top of the vessel. Gases and vapors flow through filters 41, which may be of porous Alundum or other material adapted for this specific purpose, and thence to common discharge pipe 44.

Since the synthesis reaction is highly exothermic, it is necessary to dissipate the heat of reaction. This is accomplished by circulating cooling liquids such as water or organic compounds such as diphenyl through the various cooling jackets in inner and outer vessels and through the hollow helix.

Catalyst powder rising to the top of some 3 spills over into the annular space 3a and moves downwardly and countercurrently to a rising stream of stripping gas, in this case, hydrogen. Catalyst make-up is accomplished via lines 50 and 40, being forced in by the feed gas. Used catalyst may be drawn off through line 51.

U. S. 2,562,993, issued August 7, 1951, to Eugene E. Sensel and Roland A. Beck, assignors to The Texas Co., New York.

## Patents Issued in August

*The following classified listing covers patents issued during the month of August believed to be of interest or value to petroleum processing and handling operations:*

### Processing, general

2,563,469 (David L. Sherman)—Apparatus for continuously producing combustible gas from liquid or rich gaseous hydrocarbons.
2,563,509 (The Fluor Corp.)—Valve controlled silencer for catalyst regenerator.
2,563,543 (Phillips Petroleum Co.)—Apparatus and method for controlling Btu. value, applicable to the Hypersorption process.
2,564,078 (E. I. du Pont de Nemours & Co.)—Fractionating column of the sieve-plate type.
2,564,153 (The Garrett Corp.)—Shielded heat exchanger.
2,564,833 (Union Oil Co. of California)—Sulfur dioxide process and apparatus using recycled gas.
2,565,355 (Standard Oil Development Co.)—Bubble tray and support structure.
2,565,809 (Phillips Petroleum Co.) — Pebble heating chamber.
2,565,811 (Phillips Petroleum Co.) — Pebble heater baffle.
2,566,161 (Brown Fintube Co.) — Heat exchanger.

### Catalytic Reactors

2,562,903 (Houdry Process Corp.)—Cracking apparatus of the moving bed type.
2,562,993 (The Texas Co.)—Apparatus for effecting catalytic reactions in which a rotating helical screw elevates catalyst particles through the reaction zone.
2,566,159 (Sinclair Refining Co.)—Apparatus and process for effecting chemical reactions with solid catalyst particles.

### Instruments

2,562,901 (Karl A. Fischer)—Apparatus for determining wax percentages by an electro-optical method.
2,562,997 (Wix Accessories Corp.)—Flashlight oil tester for visual inspecting for fluidity and pollution.
2,563,192 (H-P-M Development Corp.)—Pressure reducing valve.
2,563,374 (Republic Flow Meters Co.)—Pressure operated boiler feed water control.
2,563,567 (General Electric Co.) — Magnetic viscosimeter for highly corrosive liquids.
2,563,931 (Minneapolis - Honeywell Regulator Co.)—Rate responsive thermocouple.
2,564,116 (Landis & Gyr, A. G., Switzerland)—Ring balance meter for small differential fluid pressures.
2,564,294 (Minneapolis - Honeywell Regulator Co.)—Electrically operated mechanism for selectively or cyclically monitoring a number of measuring instruments.
2,564,295 (Phillips Petroleum Co.)—Safety device for relieving pressure vessels subjected to high temperature.
2,564,470 (General Electric Co.)—Continuous reading dead-weight pressure gauge.
2,564,655 (Magnetrol, Inc.)—Magnetic control device.
2,564,676 (Robert L. Crouse)—Liquid level indicator with magnetic actuated float.
2,564,892 (Fernand L. Gerin)—Viscosimeter.
2,565,230 (William O. Hebler)—Electrical gas analyzer using a resistance bridge of the Wheatstone type.
2,565,423 (McCoy Evans and R. F. Cook)—Liquid level gage and aerator.
2,565,734 (Westinghouse Electric Corp.)—X-ray thickness gauge.
2,565,963 (Ollie W. Graham)—Method and apparatus for making liquid level determinations using gamma radiation and a detector.
2,566,037 (Standard Oil Development Co.)—Apparatus for analysis by mass spectrometry.

### Tools

2,563,069 (Alfred M. Roberts)—Power-operated hack saw.
2,563,216 (Allan L. Dale)—Boiler tube gauge.
2,563,675 (Glenn Edwards) — Internal tube puller.
2,563,878 (Edwin H. Sigsbey)—Ratchet wrench.
2,566,108 (J. C. Anderson)—Chain wrench.

### Valves and Fittings

2,563,012 (Crane Co.)—Globe valve.
2,563,200 (John Venning & Co. Ltd., Alton, England)—Automatic relief valve.
2,564,147 (Leonard C. Bowling)—Valve of the plug type.
2,564,168 (Cameron Iron Works)—Plug valve for high pressure fluids.
2,564,569 (Minneapolis - Honeywell Regulator Co.)—Diaphragm control valve.
2,564,711 (Chicago Bridge & Iron Co.)—Vent for floating roof tanks.
2,564,815 (Simplex Engineering Co.)—Pressure relief valve.
2,564,894 (National Tank Co.)—Magnetic pilot valve of the diaphragm type.
2,565,244 (Milton P. Laurent)—Single lever control for a plug valve.
2,565,609 (Duriron Co.)—Automatic lubricated plug valve.

### Pumps and Compressors

2,563,257 (Ernest W. Loukonen)—Pulsation absorber for reciprocating pumps.
2,563,584 (Standard Oil Development Co.)—Device for giving shaft angular movement.
2,564,808 (Arthur F. Leis)—Rotary, positive displacement pump of the sliding vane type.
2,565,374 (Standard Oil Development Co.) — Apparatus for compounding reciprocating pumps.

### Gaskets, Seals, Packing

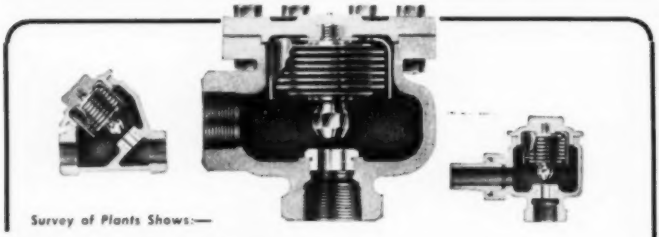
2,563,971 (P. C. Stein)—Sealing ring for reciprocating parts.
2,565,675 (Sealol Corp.)—Rotary shaft seal.
2,565,701 (J. H. F. Stewart)—Fluid sealing device for rotating shafts.

### Miscellaneous

2,562,930 (Specialties Development Corp.) — Dry-powder fire extinguishing device.
2,563,016-7 (Chicago Bridge & Iron Co.) — Floating roof storage tanks.
2,565,171 (Charles K. Huthsing, Jr.)—Apparatus for controlling corrosion in fire extinguishers.

**How to Obtain Patents**

Readers may obtain copies of any U.S. patent from the Patent Office at 25 cents each. Order by patent number direct from the Commissioner of Patents, Washington 25, D. C.

Survey of Plants Shows:—

**15 of 20 Engineers Prefer Nicholson Traps**

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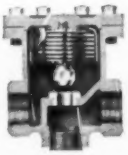

*Catalog 751 or see Sweet's*

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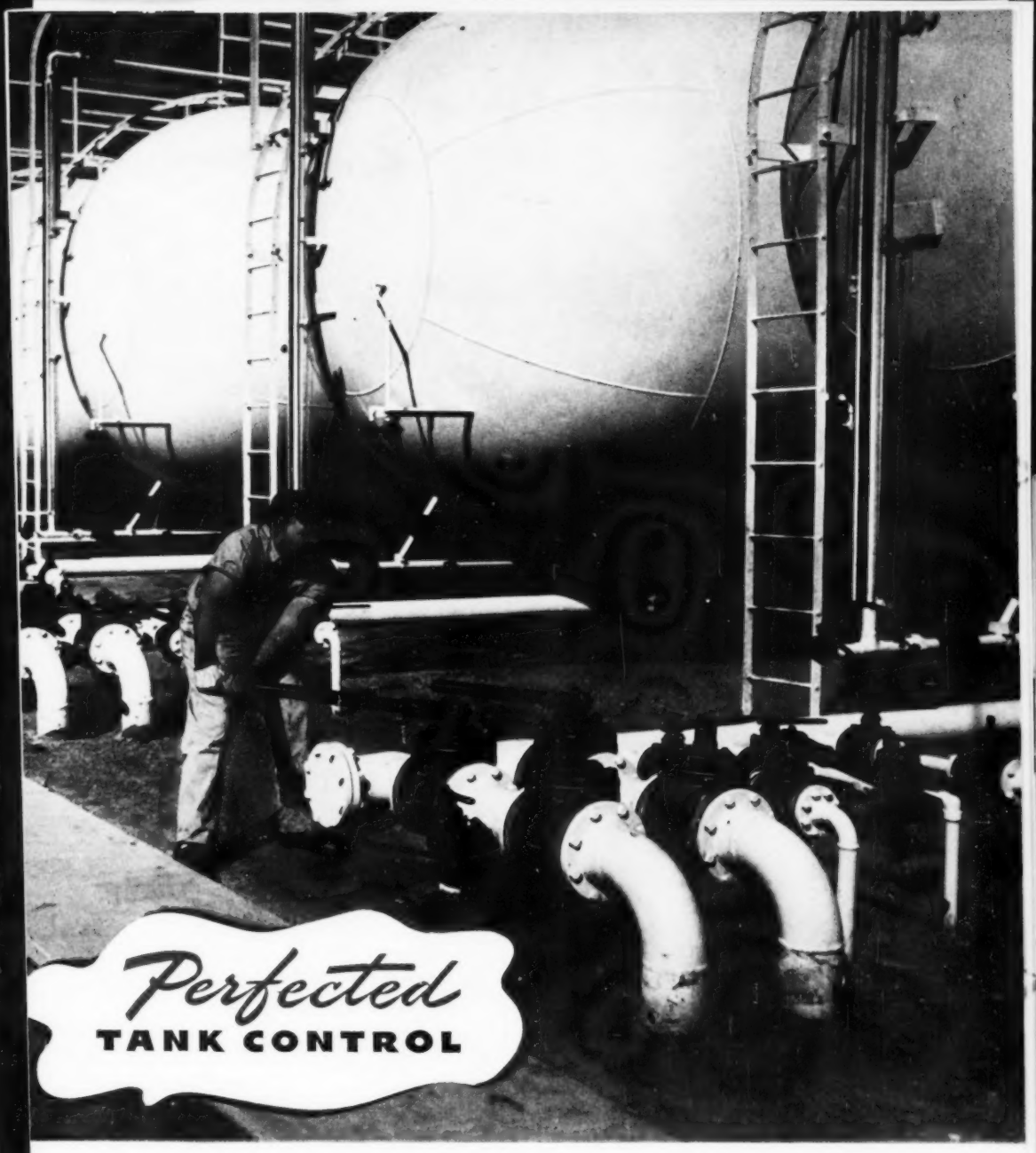


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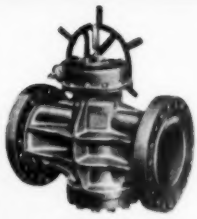
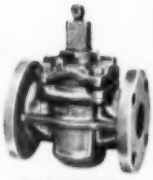


**HYPRESEAL**
Main Line Type

**HYPRESEAL**
Medium Pressure Type

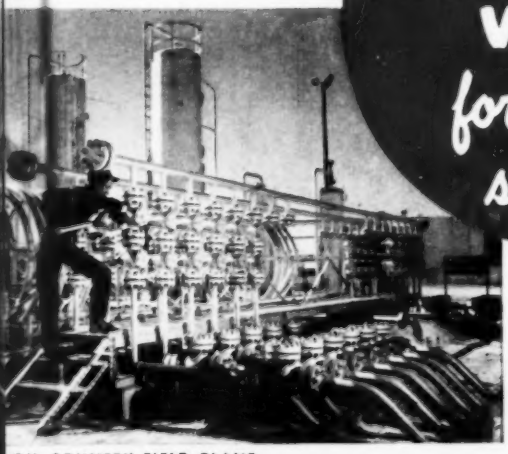
**STANDARD**
Venturi Type



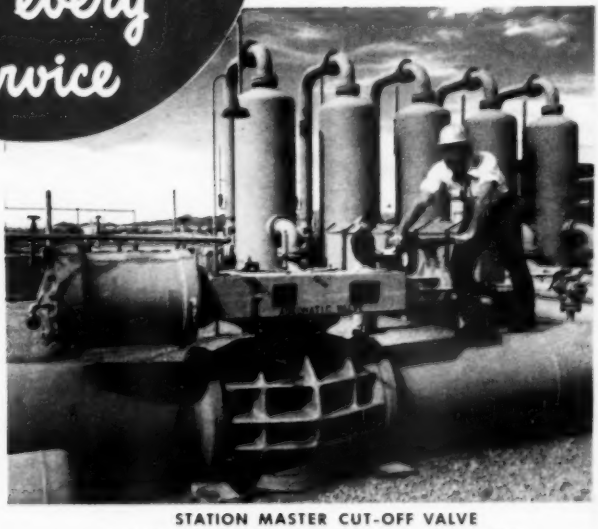
**STANDARD**
Screwed Gland Type

**TWO-BOLT**
General Service Type

**SERVICE COCK**
Lubricated

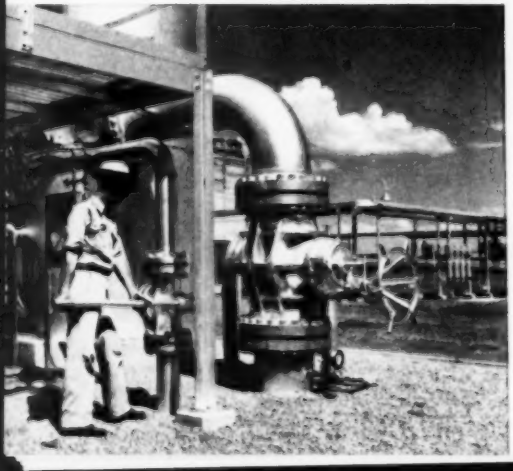


OIL COUNTRY FIELD PLANT



STATION MASTER CUT-OFF VALVE
—AUTOMATIC POWER OR MANUAL CONTROL

GAS DEHYDRATION UNIT



## Nordstrom Valves

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# NEWS OF SUPPLIERS

**Manufacturers**
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## Rockwell Makes Staff Changes

Gilbert T. Bowman has been appointed sales manager of gas products for the Meter and Valve Division, Rockwell Mfg. Co., Pittsburgh, Penna. He had joined the firm in 1939 as a sales engineer assigned to the northern California territory, and later directed sales and service of the San Francisco branch office. He will make his headquarters at Rockwell's home office in Pittsburgh.

Mr. Bowman

Mr. Kitzmiller

Replacing Mr. Bowman at San Francisco is Robert B. Kitzmiller, who first worked for the company in 1934 in Pittsburgh offices. Mr. Kitzmiller later moved to sales engineering posts in Los Angeles and in Seattle.

Hans A. Altorfer has been appointed chief engineer of Rockwell's Nordstrom Valve Division at Oakland, Calif. He has had 20 years' experience in design work with Terry Steam Turbine Co. and Allis-Chalmers Mfg. Co. and is a member of a number of technical societies including the American Petroleum Institute.

## Underground Corrosion Eliminated

A $15,000 installation of a cathodic protection system in an underground piping installation representing an estimated cost of $750,000 has virtually eliminated all corrosion, according to Harco Corp., manufacturers of the cathodic equipment. The piping comprises some 45,000 sq. ft. of metal surface located at a midwestern gas pumping station, used both to carry water to and from the compressors and water to the cooling towers. Soil conditions were such that unprotected metal pipe lasts on an average of 9 to 11 years.

Electrodes consist of a total of 80 National Carbon graphite anodes, using National Carbon Type BF-3 backfill material. General Electric rectifiers delivering an estimated power output of 130 amps. were installed to provide the current.

## Aluminum Plant Uses Lignite as Fuel

A new aluminum smelting plant for Aluminum Co. of America at Rockdale, Texas, now building and scheduled for partial operation late in 1952, will use electric power generated by burning lignite for fuel. The lignite will be mined in Milam County, in the vicinity of the power plant. This is said to be the first plant of its type to use this kind of fuel for electric power generation.

When full operation of the Alcoa facilities at Rockdale is reached in 1953, production capacity will be in the neighborhood of 170 million lbs. per year. Employment figure is expected to reach 1000.

## Bowser Adds Electronics Work

Acquisition of National Scientific Laboratories, Inc., 2010 Massachusetts Ave., N.W., Washington, D. C., by Bowser, Inc., 33 No. LaSalle St., Chicago, Ill., indicates an increase in activity in the field of electronics by Bowser.

The facilities of the Washington laboratories will be made available for development of Bowser products for the petroleum industry, railroads, and general industrial use. Special projects will include new automotive testing equipment. Dr. Robert I. Sarbacher, who organized National Scientific in 1947 and is its president, will become director of research for Bowser, and will also head the product development work of all subsidiary companies. He will remain as president of National Scientific and there will be no changes in the laboratory personnel.

## New American Meter Plant in Dallas

American Meter Co., of Philadelphia, has opened a new orifice meter plant with display rooms in Dallas, Texas. Equipment related to orifice meters, such as orifice plates, flanges, needle valves, fittings, etc., will also be produced in the new Southwestern facilities. Donald C. Holtz, of Erie, Penna., will manage the unit.

## Improved Claus Process Available

Bamag-Meguin has announced a new, improved Claus process for the recovery of elemental sulfur from hydrogen sulfide. It is said the process can be used with gases having more

## *De Laval Expands San Francisco Service Unit*

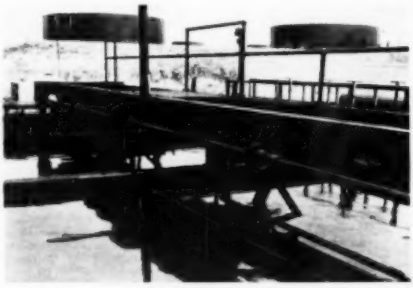
**New West Coast pump and turbine** service facilities, just completed by De Laval Steam Turbine Co. of Trenton, N. J., at 160 Folsom St., San Francisco, Calif. It will provide increased warehousing and service for standard centrifugal pumps, IMO pumps, speed reducers, and related De Laval products. The expanded activity will be under the direction of C. F. Reeves, long in charge of company's West Coast sales

Overall view of the Hardinge Rectangular Clarifier installation at Shell Oil Company's Houston refinery. The Hardinge traveling mechanism is 41'-6" across and spans two settling sections of the 60'-long oil-water separating tank.

# FOR OIL-WATER SEPARATION SHELL OIL ADOPTS HARDINGE CLARIFIER

The Hardinge Rectangular Clarifier (shown above) is in service in one of the gravity type oil-water separators at Shell Oil Company's Houston Refinery. The traveling carriage with attached duplex sediment scrapers is mounted on rails supported by the concrete walls of the separator and extending the length of the settling sections. A flexible electrical cable supported on pulleys supplies current to a one horsepower motor which operates the carriage and assemblies. This clarifier, designed for continuous operation, is controlled automatically, requiring the attention of the operator only in starting and stopping as may be desired.

During normal operation of the separator, Shell Oil finds it necessary to operate the Hardinge clarifier for only two hours each day. Following a period of heavy rainfall the period of operation is extended for removal of additional amounts of solids and slop oils entering the separator.



Close-up view of the Hardinge traveling mechanism, showing skimmers removing floating oil from the surface. This carriage also supports the sludge scrapers which remove the sediment from the bottom of the settling tank.

Sediment and sludges which accumulate on the floor of the separator are transferred by the duplex scrapers to sediment sumps recessed in the concrete floor of the separator and from which they are removed by sludge pumping facilities. Duplex skimmer blades move the slop oil at the water surface to slotted pipe skimmers which remove this oil from the separator. The maintenance of a clean separator by effective removal of sediment and slop oil using the Hardinge clarifier mechanism is a significant factor in efficient performance of the separator.

Hardinge Rectangular Clarifiers have been proved efficient for the separation of oil-water in many refinery operations during the past two years. We will be happy to send you operating data on other installations. Write today.

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YORK, PENNSYLVANIA—240 Arch St. Main Office and Works

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122 E. 42nd St. 24 California St. 205 W. Wacker Dr. 2016 First Ave. 200 Bay St.




(*To obtain more data on advertised products see page* 1164)

## News of Suppliers

than 10%-vol. $H_2S$, and results in a yield of 95% sulfur with an electrical energy consumption of 50 KWH per ton of sulfur produced. The process and equipment are available through the manufacturer's agents, General Industrial Development Corp., 270 Park Ave., New York 17, N. Y.

### Swartwout Opens Houston Office

Mr. Downey

The Swartwout Co., Cleveland, manufacturers of power plant and process control equipment, has opened a new sales office at Room 674, M&M Building, Houston, to service the Texas area. J. B. Downey will manage the power plant and process control divisions, and William A. Sharp will be in charge of roof ventilator work.

Mr. Downey, a graduate of Case Tech, was formerly with National Carbon Co. and with General Dry Batteries, Inc., in Cleveland. Mr. Sharp has served as a sales engineer in southern and central United States for several companies, the last being the Fluor Co.

Swartwout recently introduced a new all-electronic instrument transmission system. See article on Instrument Show, this issue, pages 1123-5.

### Clark Promotes Probst

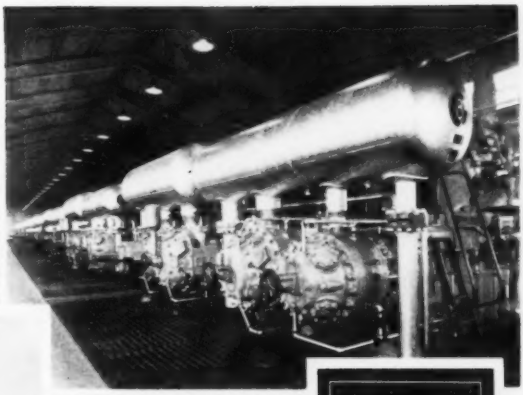
Mr. Probst

Clark Bros. Co., Inc., Olean, N. Y. engine and compressor manufacturers, has appointed George W. Probst western regional sales manager. Associated with the sales department for the past 30 years, Mr. Probst had been district sales manager in Tulsa for the past 10 years. In his new position, he will coordinate sales activities of the California, Oklahoma, Texas, and Chicago territories. His headquarters will remain at the sales office at 125 West First Street, Tulsa, Okla.

### National Airoil Executive Dies

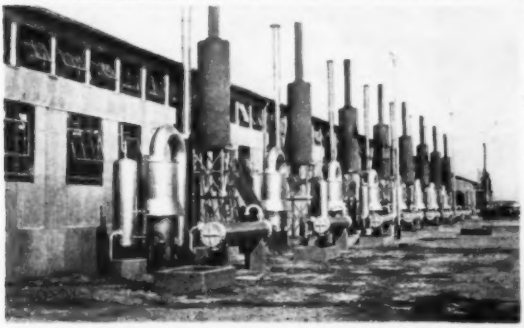
G. Frederick Bauer, 50, chief technologist of National Airoil Burner Co., Philadelphia, died August 9, in Richmond, California while on a business trip. He had been with the company 19 years, the last 12 of which

# How they lined up efficiency



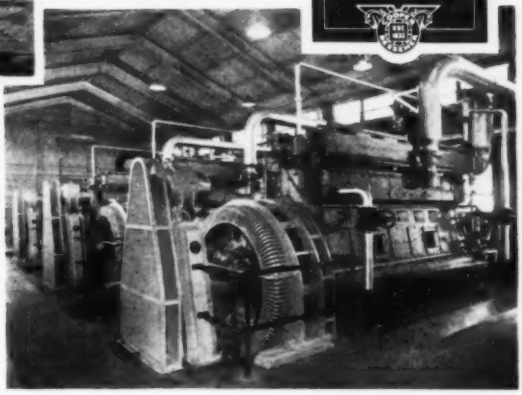
GMV'S FOR COMPRESSING

*Another Example of Efficient Power at Lower Cost*



JS' FOR GENERATING

# to save dollars at Dollarhide



● The Dollarhide Plant, operated by The Pure Oil Company, is a "beautiful" plant, say those who have seen it—one of the newest, most efficient gasoline plants today.

Those Cooper-Bessemer GMV compressors and JS gas engines do make an impressive line-up, but more important, they *line up* a combination of reliability and efficiency you just can't beat. That's why they're on this and so many other important jobs.

The compressor line consists of eight 10-cylinder GMV's, all supercharged, for a total of 10,040 compressor hp (at 3150' elevation). Each is a 3-stage compressor, zero suction to 650 lbs. discharge, with automatic speed control and manually operated unloading. This minimizes maintenance and attention without risking a suction pressure drop that would allow air to enter the sour gas stream.

There are modern Cooper-Bessemer V-angles . . . GMV's, GMX's and GMW's from 220 to 3,000 bhp . . . that will efficiently meet *your* needs no matter how exacting or complex.

**The Cooper-Bessemer Corporation**

MOUNT VERNON, OHIO — GROVE CITY, PENNA.

New York, N. Y. Washington, D. C. Bradford, Penna. Parkersburg, W. Va.
San Francisco, Calif. Houston, Dallas, Greggton, Pampa and
Odessa, Texas Seattle, Wash. Tulsa, Okla. Shreveport, La.
St. Louis, Mo. Los Angeles, Calif. Chicago, Illinois Caracas, Venezuela

# NOW EFFICIENT DESALTING IS MORE IMPORTANT THAN EVER

TD 51-2 *Photo courtesy Standard Oil Company of Ohio.*

***. . . because efficient salt removal can be an important factor in a refinery steel conservation program.***

## HERE'S HOW

**1** Salt carried over promotes the evolution of hydrochloric acid, a severe source of corrosion, especially in the overhead sections. Efficient desalting helps to prevent metal losses due to this kind of corrosion.

**2** Salt in the crude charge causes the deposition of hard, flinty coke in furnace tubes, frequently resulting in hot spots and tube failures. Also the rigorous cleaning measures required to remove hard coke are a source of tube wear and metal losses. Efficient salt removal prevents the formation of hard coke.

## TRETOLITE DESALTING *has a definite place in your steel conservation program*

Tretolite chemical desalting has proved its high efficiency in refineries everywhere. In plants with throughputs varying from 2000 b.p.d. to 50,000 b.p.d., the Tretolite process is desalting well over a million barrels daily. Salt removal percentages are in the 90 to 95% range with extremely low water, heat and chemical requirements. The flexibility of the Tretolite desalting process often permits the incorporation of existing refinery equipment in the flow scheme, holding the need for scarce new material and equipment at a minimum. Why not discuss desalting with a Tretolite engineer soon?

# TRETOLITE COMPANY

*Chemicals for the Petroleum Industry*

**ST. LOUIS 19, MISSOURI LOS ANGELES 22, CALIF.**

DESALTING • DEHYDRATING • WATER DE-OILING • CORROSION INHIBITION • SCALE PREVENTION • PARAFFIN REMOVAL

were spent entirely on combustion developments for chemical and petroleum processing. Mr. Bauer was known for his pioneering work on high temperature flame photography and the flow of gases in petroleum furnaces.

### Personnel Changes

**Hills-McCanna Co.**—Fred R. Grassle, retaining duties as secretary, appointed assistant to the president: R. T. Kidde to general sales manager of all divisions.

**Taylor Forge & Pipe Works**—Gale Carroll to the Houston district sales office, from sales and advertising manager for Tube-Kote, Inc.

**Union Carbide and Carbon Corp.**—James F. Eversole to manager of research administration, from superintendent of Linde Air Products Co. laboratories at Tonawanda, N. Y.

**Houdry Process Corp.,** Research Division Laboratories at Linwood, Pa.—Heinz Heinemann to section leader in charge of process research and E. R. Boedeker to section leader in charge of exploratory research. Two new staff additions: Dr. Sterling E. Voltz from Temple University, and Dr. Hiroshi Shimizu from the University of Utah.

**Graver Water Conditioning Co.**—Harold R. Fosnot to eastern sales manager, with headquarters at 216 West 14th St., New York, from Chicago district manager. Herman M. Ross to Fosnot's previous post in Chicago, from Cleveland district manager. Richard E. Lewis to Ross's position, from the home office in New York.

**Baldwin-Hill Co.**—J. L. Mohun to division manager at new sales office at 4101 San Jacinto St., Houston 4, Texas.

**Midwest Piping & Supply Co.**—John E. Brock to director of research, with headquarters at the main plant and executive office in St. Louis, Mo.

**Solvay Sales Division, Allied Chemical & Dye Corp.**—Lester B. Gordon to vice president from director of sales; Denman Peniston to director of sales from assistant director of sales; John H. Elleman to assistant director of sales from sales manager of the calcium chloride department.

**A. O. Smith Corp.**—John B. Madden to hydraulic sales manager for the north central district, with offices at 310 So. Michigan Ave., Chicago.

**Hardesty & Co.**—William S. Harmon to technical director, with headquarters at 3512 Cedar St., Philadel-


# Wherever AIR or GAS is used Investigate STANDARDAIRE

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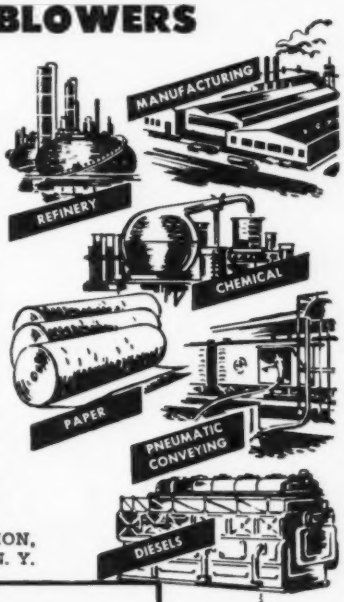
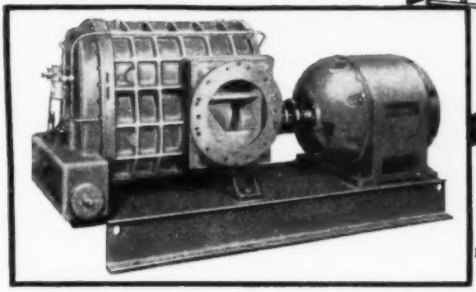
READ STANDARD'S engineered-for-production program has resulted in the acceptance of Standardaire Blowers for virtually every important industry. Blowers are currently being produced for a wide range of applications in a rapidly expanding market — and in many instances to suit specific requirements and specifications. The amazing acceptance of Standardaire Blowers is indicative of their superior operating characteristics, high efficiency and dependable performance in round-the-clock service. For further details we invite you to consult with our engineers. They will be glad to study your air or gas problems and make recommendations. Write Dept. E59

READ STANDARD CORPORATION,
370 Lexington Ave., New York 17, N. Y.



Standardaire 1218B23 Blower to deliver 2850 c.f.m. at 1160 r.p.m.

*Engineers like the STANDARDAIRE principle*

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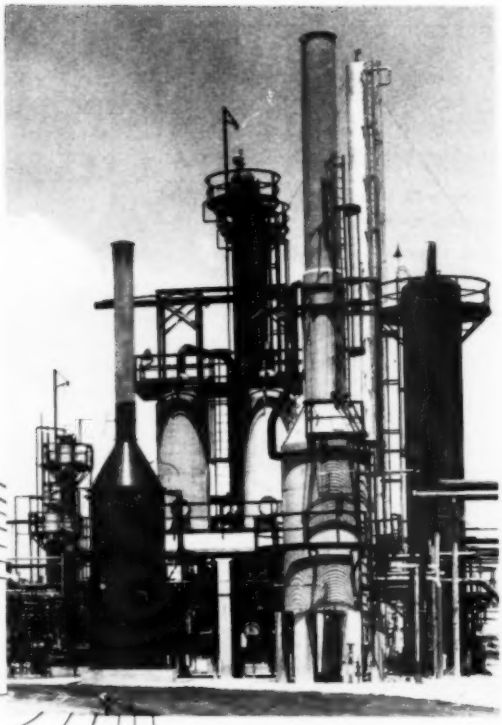
*(To obtain more data on advertised products see page 1164)*



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cycloversion*... at Peppers Refining Company, Oklahoma City

Now on stream! Design capacity—
1000 barrels per day. Now catalytically
reforming a feed stock charge of
mixed straight run naphthas
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by Koch Engineering Company.
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Write us for full information on
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PERCO DIVISION **PHILLIPS PETROLEUM COMPANY** BARTLESVILLE, OKLAHOMA

* A SERVICE MARK

phia 34, Penna., from the engineering and research departments of Merck & Co., Inc.

**Koppers Co., Inc.**—Dr. C. F. Fryling, a leader in the development of "cold" rubber, to the research department to supervise special projects of a pioneering nature, from supervisor of polymerization research for Phillips Petroleum Co.

**Fluor Corp.**—James F. Kneubuhl to New York office district sales manager, in addition to duties as assistant manager of sales. J. Simon Fluor, executive vice president, to the executive committee of the National Constructors Association.

**Southwestern Engineering Co.**—H. V. Hughes to manager of the industrial division.

**Worthington Pump & Machinery Corp.**—Charles Ebem Wilson to West Coast consultant on sales problems, from sales vice president. A veteran with 59 years' service for Worthington, Mr. Wilson retired from activities in corporation affairs on October 1, and will continue in a consulting capacity for offices in Los Angeles, San Francisco, Seattle, and Salt Lake City.

**The Austin Co.**—A. D. Engle to assistant vice president for research from Chicago district engineer. George Miller, the firm's coordinating engineer on AEC work at Oak Ridge since 1948, succeeds Mr. Engle at Chicago.

**Blaw-Knox Co.**—W. Cordes Snyder to president and chief executive officer from vice president of the Koppers Co. and manager of its metallurgical department. William P. Witherow, formerly president and chairman of Blaw-Knox, continues as board chairman.

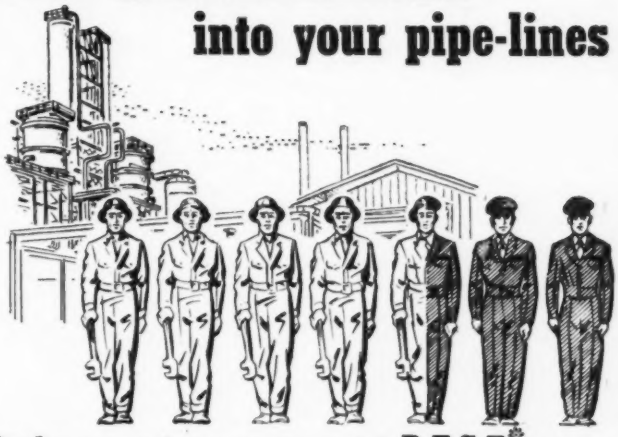
### Expansion, Transition

The corporate name of Southern Alkali Corp. has been changed to **Columbia-Southern Chemical Corp.** It is a wholly-owned subsidiary of Pittsburgh Plate Glass Co. Clarence M. Brown, chairman of the board for both PPG and Columbia-Southern stated that the action involves a change in name only. Personnel, policies, and customer relations will not be affected, he said.

**American Cyanamid Co.** has consolidated its several office and warehouse locations in Los Angeles, into one newly-constructed building at 2300 So. Eastern Ave.

**Babcock & Wilcox Tube Co.'s** Beaver Falls local district sales headquarters have been moved from the plant to a new office in the city's business section, at 712 Eleventh Street.


# Build STAMINA into your pipe-lines



## *Reduce maintenance with* D-F S-E* *Joints*

Shortages of manpower require you to build stamina in your lines. **Directed-Flexing Self-Equalizing*, an exclusive feature of Badger Expansion joints, assures all-curve flexing in the corrugated member. Thus, localized flexing stresses cannot form . . . metal fatigue cut to a minimum . . . breakdowns are virtually eliminated.

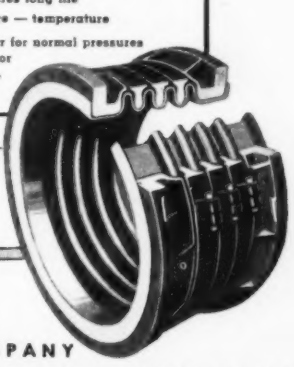
But that's not the whole Badger story. In addition to controlling the flexing movement *within* each corrugation, the specially designed Self-Equalizing Rings also control intra-corrugation movement. For unbeatable stamina be sure you get the exclusive Badger combination — Directed-Flexing Self-Equalizing — when you buy . . . specify Badger Expansion joints for every job.

Only Badger Expansion Joints have Directed-Flexing Self-Equalizing rings which progressively control the movement of the all-curve corrugations.

Plus 5 other big features

- Packless . . . pressure-tight single tube — requires no maintenance
- Compact . . . approximately the size of flanged fitting
- Special forming . . . no structure weakening stresses
- Controlled heat treating . . . assures long life
- Wide range of traverse — pressure — temperature

Fabricated from deoxidized copper for normal pressures and temperatures, stainless steel or alloys to withstand high pressure, temperature and corrosion.



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HEATED

**Badger**

MANUFACTURING COMPANY

230 BENT STREET, CAMBRIDGE, MASS.

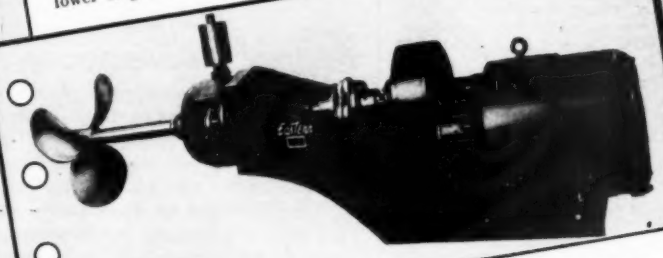



(To obtain more data on advertised products see page 1164)

# ..EQUIPMENT NOTES

## TOP ENTERING MIXERS

Eastern Series C Vertical Mixers are applicable to a wide variety of specialized needs. They're designed for tanks needing agitators with a range of 1/4 to 10 H.P. at standard speeds of 1725, 1140, 420 and 280 R.P.M. They have standard NEMA ball-bearing type motor with a rigid-type coupling between motor shaft and propeller shaft. Stuffing box is separate component and can be made of any alloy, allowing lower original cost.



## HEAVY-DUTY SIDE ENTERING MIXERS

Eastern Series A Mixers are extra heavy-duty machines for large tank capacity. They range from 5—30 H.P. at standard speeds of 1150, 420, and 280 R.P.M. Shaft is coupled to standard motor by flexible coupling, and the shaft and bearing housing move as single unit to allow easy adjustment and repair. Stuffing box is repackable with full tank.

Eastern

***Catalog sent on request . . .***

**The complete Eastern catalog of Fixed Mounting Mixers, both Top and Side Entering, is yours on request. Ask for Bulletin TD-600.**

**EASTERN INDUSTRIES, INC.**

**• • • NORWALK, CONN. • • •**

# Authors Rewrite Completely Their Gas Combustion Text

*Combustion, Flames, and Explosions of Gases*, by Lewis and von Elbe; 6 x 9 in., xix + 795 pages, stiff cloth binding, indexed, illustrated, $13.50. Academic Press, Inc., 125 East 23rd St., New York, 10, N. Y.

Thirteen years ago the same authors wrote and published a book on the same subject and under the same title—*Combustion, Flames, and Explosions of Gases*. There, however, the similarity ends. The present book is not a second edition because, as the authors state in the preface, " . . . the text is entirely new with the exception of a few brief sections dealing with subjects that had already been well explored at the time. The purpose of the new volume remains the same however, namely, to provide the chemist, physicist, and engineer with the scientific basis for understanding combustion phenomena."

This book should prove of value as the standard text on this subject to the growing profession of combustion engineering, to workers in fuels for internal combustion engines, turbines, jet engines, etc., to safety engineers, and to all gas engineers. It is divided into four major parts: 1) chemistry and kinetics of the reactions between fuel gases and oxygen, 2) flame propagation, 3) state of the burned gas, and 4) problems in technical combustion processes. Chapter headings reveal the kind of essential knowledge to be obtained: reactions between hydrogen and oxygen, carbon monoxide and oxygen, and hydrocarbons and oxygen; flame photography and pressure recording; combustion waves; combustion waves in turbulent and non-turbulent explosive gases; mixing and combustion in fuel jets; internal combustion engines, etc. An extensive appendix includes data for thermochemical calculations, limits of inflammability, and flame temperatures.

The importance of a book like this to engine research is perhaps best evaluated in the authors' own words, in concluding the preface:

"Fundamental research should ultimately contribute toward improved understanding and control of technical combustion processes, particularly in engines. To accomplish this it is necessary to analyze the engine process in terms of the fundamental physical and chemical processes that occur in the various phases of starting and operation. At present this has been pursued to only a very small extent. Too often engine studies are confined to observations of the effect of fuel and engineering variables on over-all performance in a manner that excludes the possibility of recognizing the controlling physical and chemical processes. While development of modern engines has been eminently successful, this success has only been made possible by the accumulation of a very large volume of empirical information and by the continual maintenance of large and costly testing facilities. The question may be asked whether timely fundamental research could not have eliminated a large portion of this testing that has been carried on and is still continuing on a world-wide scale, and whether practical developments could not have been materially facilitated by scientific knowledge. In this text some attempt has been made to collect the meager information of fundamental character, first, to show that in principle it appears quite feasible to estimate the knock-limited performance of an Otto engine in a rather simple manner, and second, to illustrate that in jet engines a close scrutiny of the flame structure might lead to useful information on performance limits."

The authors, Drs. Bernard Lewis and Guenther von Elbe, are physical chemists in the Explosives and Physical Sciences Division, U. S. Bureau of Mines, Pittsburgh.

## Story of a Pioneering Chemist Makes Entertaining Reading

*Herbert H. Dow, Pioneer in Creative Chemistry*; by Murray Campbell and Harrison Hatton; 7 x 10 in., xi + 168 pages, illustrated, stiff cloth binding, $3.50. Appleton-Century-Crofts, Inc., 35 West 32nd St., New York 1, N. Y.

Practically every book that reaches this reviewer's desk is a technical or scientific treatise, designed to help the reader gain new fundamental knowledge or at least to gain information and data which will help him do a better job at his every-day career.

It's therefore a pleasant interlude when a book comes along that's more in the category of pure entertainment, that's in non-technical terms and a bit of history or education of a different kind. *Herbert H. Dow, Pioneer in Creative Chemistry* is such a book.

True, it tells the story of a great company, and of the great industry which that company serves; but also it tells the story of an important American. It tells what kind of a man he was—his dogged perseverance, his vision, and his pioneering spirit. Herbert Henry Dow entered an industry in its infancy, and he built a great company in that industry. We have to use a cliche to say it, but he had to dig in and learn the things he used the hard way. And it was his own inborn talents plus a group of men of the same caliber he had gathered about him that carried his little company up to the giant it has become today.

The story is told—and told very well—in chrononological fashion. It is excellently illustrated with pictures, many being fine reproductions of old photographs of the early chemical plants built by Dow. The narrative relates the major achievements of the man and his company in chlorine and bromine chemistry, as well as many others including work in synthetic dyes, in carbon tetrachloride, and various hydrocarbons. It is definitely "recommended reading."

## API Publishes Guidebook on Safety, First-Aid Training

The American Petroleum Institute has published a First-Aid and Safety-Training Guide. This guide outlines a training course which covers six emergency measures necessary to make an injured person comfortable until he can receive the attention of a physician.

The six measures include: artificial respiration, control of bleeding, treatment for shock, care of open wounds and burns, care of dislocations and fractures, and transportation of the injured. The guide also outlines the petroleum industry's program for the safety of the individual employe, as well the personal protective equipment available and its function. The training course is designed to extend over a period of eight hours, six of which are devoted to first aid and the other two to safety.

Printed in two colors on 64 pages, the guide may be purchased from the API, 50 West 50th St., New York 20, N. Y., in two sizes and styles as follows:

1. "Safetygraph" size (22 x 17 in.) for use in class instruction: single copy is $25.00 each; more than one copy at prices ranging down to $8.00 each for 31 or more copies.

2. "Pamphlet" size (7 x 5½ in.) for use by individual students: single copy is $1.00; more than one at prices ranging down to 60c each for 5000 or more copies.

## Government Publications

*Investigation of a Photoelectric Device for the Determination of Low Concentrations of Dust*, Bureau of Mines Report of Investigations 4782, March, 1951, by D. E. Stone, L. J. Kane, T. E. Corrigan, H. W. Wainwright, and C. B. Seibert; 8 x 10½ in., six pages, illust., heavy paper cover.

Order copies of the above free booklet from the U. S. Bureau of Mines, Publications Distribution Section, 4800 Forbes St., Pittsburgh 13, Penna.

# *Which comes first—* STEEL *or* OIL?

STEEL and oil have become as closely related as the chicken and the egg. Any sizable increase in steel production calls for a like increase in oil producing and refining capacity. More steel means more machines, ships, locomotives, trucks, planes and a myriad of other steel products that need fuels and lubricants. And that will take more steel to drill wells and to build pipe lines and refineries.

New steel plants and refineries are both "first" at McKee—and both in a hurry. McKee maintains separate divisions for iron and steel plant and petroleum refinery design, engineering and construction. The combined technical knowledge and experience of these two divisions are particularly advantageous to McKee clients in the present expansion program.

**DESIGN, ENGINEERING AND CONSTRUCTION FOR THE PETROLEUM REFINING AND IRON AND STEEL INDUSTRIES**

**McKee** *Engineering*

**Arthur G. McKee & Company · Established 1905**

*Headquarters:* McKee Building, 2300 Chester Avenue, Cleveland 1, Ohio. *New York:* 30 Rockefeller Plaza, New York 20, N. Y. *Tulsa:* 2803 West 40th Street, Tulsa 7, Oklahoma. *England:* The Iron and Steel Division of Arthur G. McKee & Company, is represented by Head, Wrightson & Co., Ltd.

# API Annual Meet Back to Chicago; Chapman and Bradley Will Speak

SECRETARY of the Interior Oscar L. Chapman and General of the Army Omar N. Bradley are among the speakers who will address the 31st annual meeting of the American Petroleum Institute in Chicago, November 5-8, at the Stevens Hotel and the Palmer House. Their topics have not as yet been announced.

Other prominent speakers for the general sessions at this year's meeting include Governor Allan Shivers of Texas; Frank M. Porter, president of the API, and the 1950 recipient of the API "Gold Medal for Distinguished Achievement." Presiding at both general sessions will be W. Alton Jones, chairman of the API board of directors, and president of Cities Service Oil Co.

The identity of the man who will receive this year's gold medal will not be known until later, according to the API department of information. Previous recipients include Henry Ford, Dr. William M. Burton, Dr. Charles F. Kettering, J. Howard Pew, and Walter C. Teagle.

Among group sessions which will be of interest to petroleum processing men is one on Monday, Nov. 5, at 8:00 p.m. on the Protection of Petroleum Facilities. Rear Admiral B. B. Biggs of the Munitions Board will discuss "Effect of Plant Security upon Military Supply;" Vice Admiral Merlin O'Neill, Commandant, U. S. Coast Guard, will talk on "Port Security;" and Ned H. Dearborn, president the National Safety Council, will cover "Personnel Security." Speakers for the group session of the Refining Division on Wednesday, November 7, at 2:00 p.m., have not yet been announced.

There will be more than 100 committee sessions during the annual meeting, some getting under way as early as Friday, November 2. The following subcommittees of the Refining Division will hold meetings during that time: corrosion, field-assembled pressure vessels, valves, petroleum products, pressure-relieving systems, automotive research, un-fired pressure vessels, mechanical equipment, electrical equipment, and instruments.

In addition, the following manufacturers' subcommittees will meet: safety and relief valves, field-assembled pressure vessels, centrifugal pumps. Meetings will also be held by the following full committees of the Division: refinery equipment, nominating, program, advisory, and general.

## NGAA—Date Changed

THE date has been changed for the Panhandle-Plains regional meeting of the Natural Gasoline Association of America. Originally scheduled for Friday, December 7, the meeting will be held Tuesday, November 20, at the Herring Hotel, Amarillo, Texas.

Decision was made at a recent meeting of the NGAA program committee, according to John Kindle, Lone Star Producing Co., chairman. The committee said arrangements have been made with the hotel to move forward to the new date all room reservations made for the meeting as originally scheduled.

## Packaging Institute Forum

A FULL day petroleum packaging seminar has been included in the three-day program of the 13th Annual Forum of the Packaging Institute at Hotel Commodore, New York City, October 22-24.

Set for 9:00 a.m., Wednesday, Oct. 24, the seminar will be under the chairmanship of R. Chester Reed, The Texas Co. The morning session begins with a progress report by a panel group including A. D. Murphy, Esso Standard Oil Co.; F. N. Landon, Sun Oil Co.; Glenn Whetzell, Standard Oil Co. of Indiana; F. J. Beck, Cities Service Oil Co.; G. B. Nelson, Shell Oil Co.; W. J. Wood, Atlantic Refining Co.; and Mr. Reed.

This will be followed by a paper, "Statistical Quality Control Methods Applied to Can Filling Operations," by Robert Mellon, Gulf Oil Corp., and another, "Subsurface Drum Filling," by Fred W. Langner, Socony-Vacuum Oil Co., Inc.

Two papers and a motion picture are on the afternoon program, beginning at 2:00 p.m. The motion picture is on the manufacturing process for metal drums, and is being given by Rheem Manufacturing Co. The papers include one on "Petroleum Packaging for the Military," speaker to be announced; and "American Standards, What Are They and How are They Established?" by Cyril Ainsworth of the American Standards Association.

## NACE—Regional Meeting

CORROSION prevention in refineries, natural gasoline plants and chemical plants will be covered in some of the papers scheduled for the October 17-20 south central regional meeting of the National Association of Corrosion Engineers, at the Robert Driscoll Hotel, Corpus Christi, Texas.

Included on the program for a symposium on Thursday, October 18, are the following subjects:

"Some Observations on Atmospheric and Sea Water Corrosion at the Dow Chemical Co., Texas Division," W. B. Brooks, Dow Chemical Co.

"Refinery Painting," W. B. Cook, Gulf Oil Corp.

"Paint Formulation and Manufacture," John W. Nee, Briner Paint Mfg. Co., Inc.

"Corrosion in Chemical Plants," Clyde W. Day, Celanese Corp. of America.

"Corrosion Inhibition in Gas Condensate Wells by Intermittent Injection of Alkaline Solutions," Charles C. Nathan, The Texas Co.

"Corrosion and Corrosion Prevention in Natural Gasoline Plants," Jim H. Zike, Haynesville Operator Committee.

## Oil Man's Calendar

OCTOBER

**14-20, OIL PROGRESS WEEK**

**14-20, Oil Industry Information Committee,** Oil Progress Week meeting, Roosevelt Hotel, New Orleans, La.

**15-17, American Gas Association,** annual convention, Kiel Auditorium, St. Louis, Mo.

**15-19, National Metal Congress & Exposition,** Detroit: American Society for Metals and the Society for Non-Destructive Testing, Hotel Statler; American Welding Society, Hotel Book-Cadillac; American Institute of Mining & Metallurgical Engineers, Hotel Detroit-Leland.

**18-19, Scientific Apparatus Makers Ass'n.,** midyear meeting, Industrial Instruments Section, Seaview Country Club, Absecon, N. J.

**18-20, National Association of Corrosion Engineers,** south central region annual meeting, Corpus Christi, Texas.

**19, Natural Gasoline Assn. of America,** Southern regional meeting, Blackstone Hotel, Tyler, Texas.

**22-24, Packaging Institute,** 13th annual forum, Hotel Commodore, New York.

**22-26, American Institute of Electrical Engineers,** fall general meeting, Hotel Cleveland, Cleveland, Ohio.

**29-30, Society of Automotive Engineers,** Diesel engine meeting, Drake Hotel, Chicago.

**29-31, Society of Automotive Engineers,** transportation meeting, Hotel Knickerbocker, Chicago.

**29-31, National Lubricating Grease Institute,** 19th annual meeting, Edgewater Beach Hotel, Chicago.

**31-Nov. 1, Society of Automotive Engineers,** fuels and lubricants meeting, Drake Hotel, Chicago.

NOVEMBER

**5-8, American Petroleum Institute,** 31st annual meeting, Stevens and Palmer House Hotels, Chicago.

**8-10, Seminar—Operations Research in Industry and Business,** Case Institute of Technology, Cleveland, Ohio.

# Stabilized Geared

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# REFINING TRENDS

**Current Data on Crude Runs, Product Supply and Demand**

## 142,000 B/D Avg. Coming From Refiners In the U.S. To Replace Loss of Abadan

INDICATED crude runs to stills in September were at an all-time high of around 6,600,000 b/d avg. This high rate of plant operations is largely offset, however, by continued strong domestic demand and by export shipments to Anglo-Iranian Oil Co. accounts to make up for the closing of the big Abadan refinery. Present commitments on U. S. refiners call for the shipping to such accounts of an average of 142,000 b/d over the last six months of the year. The total of nearly 26,000,000 bbls. includes motor and aviation gasoline, distillate products and heavy fuel oil.

The increased volume of crude run to stills is reflected in high motor fuel output, the indicated rate for September being around 3,200,000 b/d avg., about at the level maintained for the past four months. Gasoline produced from crude oil is at the high rate of around 2,850,000 b/d, 11.3% greater than for September, '50.

For 8 months the production of gasoline from crude has been 12.6% larger than for the same period in 1950. The volume of natural gas liquids going into motor fuel in the same period has been just under 10% more than in the 1950 8-month period. Total production of motor fuel for 8 months has been 12.3% larger than in the same period last year.

Indicated motor fuel demand in September was around 3,300,000 b/d avg., not far below the peak for the season of around 3,800,000 b/d. Indicated demand for this product in September is 12.1% greater than in September, 1950, while demand for 8 months has been 11.6% greater than the year previous.

Gasoline stocks in the U. S. were 113,072,000 bbls. total on Sept. 22, 1951 (API data), close to the low point of their normal seasonal decline. This volume is around 8,330,000 bbls. (8% approximately) larger than the 104,740,000 bbls. in storage on Sept. 23, 1950 (API data). This additional volume does not appear abnormally large, since demand for this product this year has been nearly 12% larger than in 1950.

The rate of withdrawals of gasoline stocks in September continues at around 100,000 b/d. as compared with 165,000 b/d in August, both months being higher than in 1950 and reflecting the shipments from refineries in this country to companies abroad to replace oil lost through the closing of the Abadan refinery.

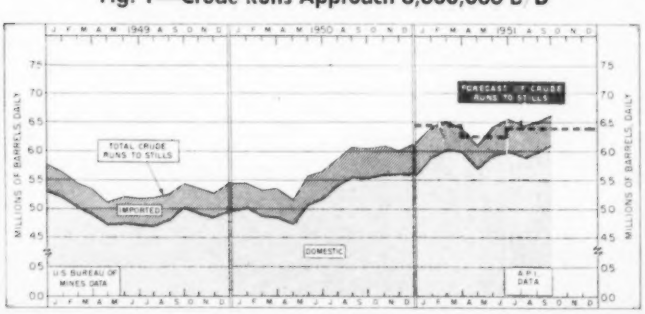
Indicated refinery output of heating oils (kerosine and distillate fuels) in September is at a rate about 9.4% greater than in September, 1950, and the total of 1,655,000 b/d avg. output is the highest on record. For 8 months of this year production of heating oils has been at a rate over 24% greater in 1951 than in 1950. Indicated heating oil demand in September shows a slackening from August, a normal occurrence preliminary to the upsurge in demand when the heating season gets under way.

Heating oil stocks by Sept. 22 had reached the record figure of nearly 128,700,000 bbls. as compared with around 106,000,000 bbls. on Sept. 30, 1950. For the entire country, the buildup in these stocks since March 31 has been over 72,000,000 bbls., as compared with around 52,000,000 bbls. from March 31-Sept. 30, 1950. For the territory east of California, the buildup in heating oil stocks in this period this year has been about 70,800,000 bbls. as compared with 48,750,000 in the 1950 period. In view of the anticipated high domestic demand for heating oils in the coming heating season and the fact that shipments to former Iranian Oil Co. customers abroad of kerosine and distillate fuel oils amount to over 9,000,000 bbls. over the last 6 months of this year, the total is not considered unduly high.

Residual fuel oil demand shows the smallest increase of any refined product for the year, the rate of increase being about 5% for 8 months, reflecting the shift of users to other forms of fuel. Refinery production, due to the larger volume of crude run to stills, has been 15.5% larger for the same period. Total stocks for the U. S., around 47,640,000 bbls. Sept. 22 (API data), are about 5,680,000 bbls. greater than on Sept. 30, 1950. East of California stocks were about 31,900,000 bbls. Sept. 22, around 3,500,000 bbls. larger than on Sept. 30, 1950.

In the period from April 30, 1951-Sept. 22 this year U. S. stocks of residual fuel oil built up by 10,700,000 bbls. In the same period in 1950 they increased by just under 2,000,000 bbls. In the 1950 period, stocks east of California increased by about the same amount as this year. However, California stocks decreased about 6,000,000 bbls. in the same period.

**Fig. 1—Crude Runs Approach 6,600,000 B/D**


J F M A M 1949 A S O N D J F M A M 1950 A S O N D J F M A M 1951 A S O N D
MILLIONS OF BARRELS DAILY
FORECAST OF CRUDE RUNS TO STILLS
TOTAL CRUDE RUNS TO STILLS
IMPORTED
DOMESTIC
U.S. BUREAU OF MINES DATA
API DATA

### Crude Runs to Stills

Daily Average (1000 bbls.)

| | Domestic | Foreign | TOTAL |
|---|---|---|---|
| Sept. '51 API* | 6,100 | 505 | 6,605 |
| Sept. '50 BM | 5,527 | 532 | 6,059 |
| Change | +573 | −27 | +546 |
| % Change | 10.4 | 5.1 | 9.0 |

* Through Sept. 22

Total (1000 bbls.)
(Bureau of Mines Data)

| | | | |
|---|---|---|---|
| 8 Mo. '51* | 1,445,390 | 125,197 | 1,570,587 |
| 8 Mo. '50 | 1,240,223 | 115,486 | 1,351,709 |
| Change | +209,167 | +9,711 | +218,878 |
| % Change | 16.9 | 8.4 | 16.2 |

* August from API data

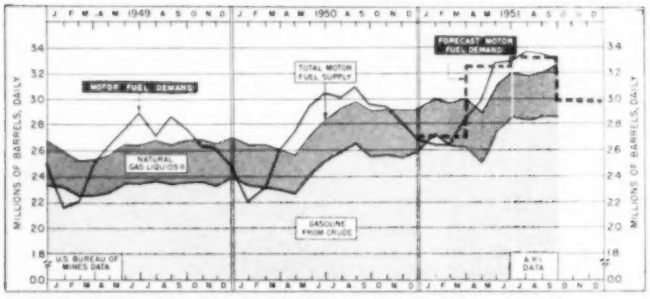
BM Forecast of Runs to Stills, 1951
(revised, June 1; 1000 b/d avg. by Quarters)
1st Q., 6,492; 2d Q., 6,331; 3d Q., 6,430; 4th Q., 6,433

### Yields on Crude Runs to Stills

| | Gasoline % | Kerosine % | Dist. Fuels % | Resid. Fuels % |
|---|---|---|---|---|
| Sept. '51 API* | 43.2 | 5.4 | 19.6 | 18.6 |
| Aug. '51 API | 43.5 | 5.3 | 19.4 | 18.9 |
| July '51 BM | 43.2 | 5.0 | 18.7 | 19.5 |
| Sept. '50 BM | 42.4 | 5.5 | 19.5 | 19.4 |

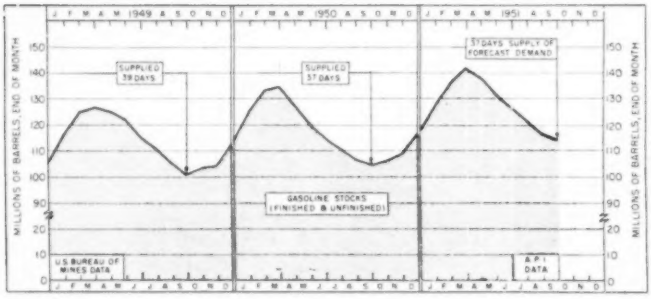
* Through Sept. 22

## Fig. 2—Gasoline Production Highest of Year

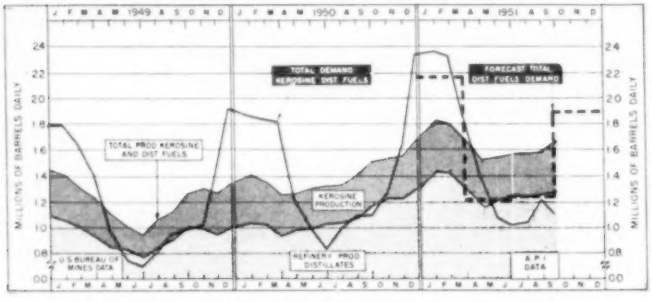

J F M A M 1949 A S O N D
J F M A M 1950 A S O N D
J F M A M 1951 A S O N D
MOTOR FUEL DEMAND
TOTAL MOTOR FUEL SUPPLY
FORECAST MOTOR FUEL DEMAND
NATURAL GAS LIQUIDS
GASOLINE FROM CRUDE
U.S. BUREAU OF MINES DATA
A.P.I. DATA
MILLIONS OF BARRELS, DAILY

*Natural Gas Liquids include gasoline blended at refineries, and used direct as motor fuel.

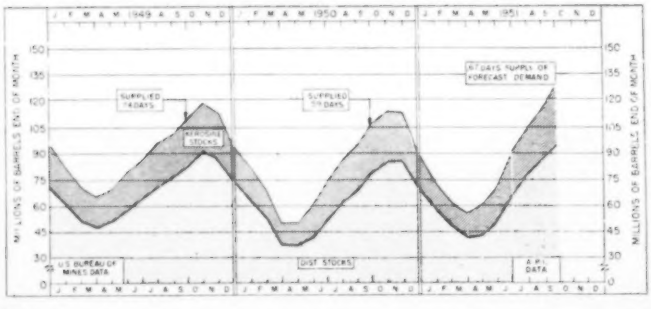
## Fig. 3—Draft on Gasoline Stocks Lessens


J F M A M 1949 A S O N D
J F M A M 1950 A S O N D
J F M A M 1951 A S O N D
SUPPLIED 39 DAYS
SUPPLIED 37 DAYS
37 DAYS SUPPLY OF FORECAST DEMAND
GASOLINE STOCKS (FINISHED & UNFINISHED)
U.S. BUREAU OF MINES DATA
A.P.I. DATA
MILLIONS OF BARRELS, END OF MONTH

## Fig. 4—Breathing Spell in Heating Oil Demand


J F M A M 1949 A S O N D
J F M A M 1950 A S O N D
J F M A M 1951 A S O N D
TOTAL DEMAND KEROSINE DIST FUELS
FORECAST TOTAL DIST FUELS DEMAND
TOTAL PROD KEROSINE AND DIST FUELS
KEROSINE PRODUCTION
REFINERY PROD DISTILLATES
U.S. BUREAU OF MINES DATA
A.P.I. DATA
MILLIONS OF BARRELS DAILY

## Fig. 5—Heating Oil Stocks Climb to New High


J F M A M 1949 A S O N D
F M A M 1950 A S O N D
J F M A M 1951 A S O N D
SUPPLIED 14 DAYS
SUPPLIED 19 DAYS
67 DAYS SUPPLY OF FORECAST DEMAND
KEROSINE STOCKS
DIST. STOCKS
U.S. BUREAU OF MINES DATA
A.P.I. DATA
MILLIONS OF BARRELS, END OF MONTH

## Motor Fuel Supply

Daily Average (1000 bbls.)

| | Gasoline from Crude | Natural Blended Used Direct | TOTAL |
|---|---|---|---|
| Sept. '51 API* | 2,855 | 375 | 3,230 |
| Sept. '50 BM | 2,565 | 353 | 2,918 |
| Change | +290 | +22 | +312 |
| % Change | 11.3 | 6.1 | 10.7 |

* Through Sept. 22

Total (1000 bbls.)
(Bureau of Mines Data)

| | | | |
|---|---|---|---|
| 8 Mo. '51* | 604,262 | 85,839 | 750,101 |
| 8 Mo. '50 | 589,663 | 78,062 | 667,725 |
| Change | +74,599 | +7,777 | +82,376 |
| % Change | 12.6 | 9.9 | 12.3 |

*August from API data

## Motor Fuel Demand

Including Exports
Daily Average (1000 bbls.)

| | |
|---|---|
| Sept. '51 API* | 3,330 |
| Sept. '50 BM | 2,971 |
| Change | +359 |
| % Change | 12.1 |

* Through Sept. 22

Total (1000 bbls.)
(Bureau of Mines Data)

| | |
|---|---|
| 8 Mo. '51* | 748,030 |
| 8 Mo. '50 | 670,066 |
| Change | +77,964 |
| % Change | 11.6 |

* August from API data

BM Forecast of Motor Fuel Demand, 1951
(revised, June 1; 1000 bbl avg. by Quarters)
1st Q., 2,733; 2d Q., 3,265; 3d Q., 3,337; 4th Q., 3,076

## Gasoline Stocks

Finished and unfinished, end of month (1000 bbls.)

| | |
|---|---|
| Sept. '51 API* | 113,072 |
| August '51 API | 115,205 |
| July '51 BM | 121,482 |
| Sept. '50 BM | 105,748 |

* On Sept. 22

## Heating Oils Production

(Kerosine and Distillates)
Daily Average (1000 bbls.)

| | Kerosine | Dist. Fuels | TOTAL |
|---|---|---|---|
| Sept. '51 API* | 360 | 1,295 | 1,655 |
| Sept. '50 BM | 333 | 1,180 | 1,513 |
| Change | +27 | +115 | +142 |
| % Change | 8.1 | 9.7 | 9.4 |

* Through Sept. 22

Total (1000 bbls.)
(Bureau of Mines Data)

| | | | |
|---|---|---|---|
| 8 Mo. '51* | 90,006 | 313,178 | 403,184 |
| 8 Mo. '50 | 76,743 | 247,639 | 324,382 |
| Change | +13,263 | +65,539 | +78,802 |
| % Change | 17.3 | 26.4 | 24.3 |

*August from API data

## Heating Oils Demand

Daily Average (1000 bbls.)

| | Kerosine | Dist. Fuels | TOTAL |
|---|---|---|---|
| Sept. '51 API* | 215 | 925 | 1,140 |
| Sept. '50 BM | 270 | 864 | 1,134 |
| Change | −55 | +61 | +6 |
| % Change | 20.4 | 7.1 | .60 |

* Through Sept. 22

Total (1000 bbls.)
(Bureau of Mines Data)

| | | | |
|---|---|---|---|
| 8 Mo. '51* | 79,484 | 298,620 | 378,104 |
| 8 Mo. '50 | 72,073 | 257,506 | 329,579 |
| Change | +7,411 | +41,114 | +48,525 |
| % Change | 10.3 | 15.9 | 14.7 |

* August from API data

BM Forecast of Heating Oils Demand, 1951
(Kerosine and Distillates)
(revised, June 1; 1000 bbl avg. by Quarters)
1st Q., 2,198; 2d Q., 1,220; 3d Q., 1,240; 4th Q., 1,902

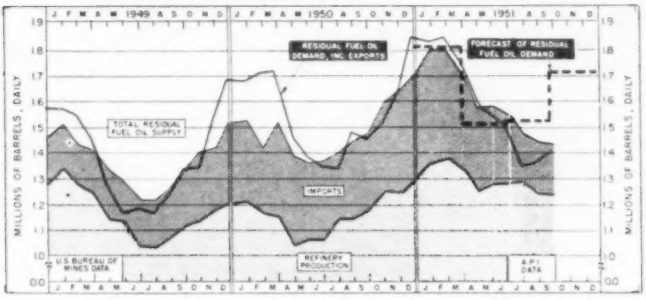
## Heating Oil Stocks

* (1000 bbls. end of month)

| | Kerosine | Dist. Fuels | TOTAL |
|---|---|---|---|
| Sept. '51 API* | 33,529 | 95,164 | 128,693 |
| August '51 API | 30,284 | 87,305 | 117,340 |
| July '51 BM | 27,265 | 77,864 | 105,129 |
| Sept. '50 BM | 27,677 | 78,270 | 105,947 |

* On Sept. 22

## Fig. 6—Residual Fuel Demand Swings Upward




### Residual Fuels Production

Daily Average (1000 bbls.)

| | | | |
|---|---|---|---|
| Sept. '51 API* | 1,230 | 200 | 1,430 |
| Sept. '50 BM | 1,178 | 302 | 1,480 |
| Change | +52 | −102 | −50 |
| % Change | 4.4 | 33.7 | 3.4 |

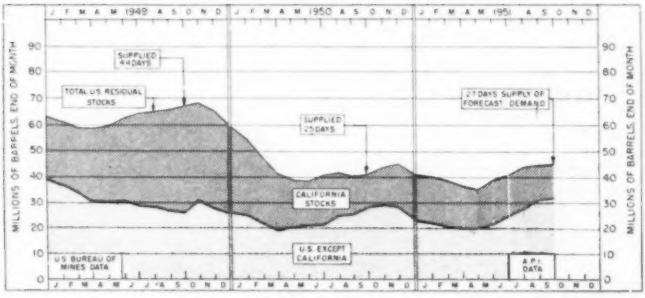
* Through Sept. 22

Total (1000 bbls.)
(Bureau of Mines Data)

| | | | |
|---|---|---|---|
| 8 Mo. '51* | 315,772 | 78,220 | 393,992 |
| 8 Mo. '50 | 273,438 | 75,026 | 348,464 |
| Change | +42,334 | +3,194 | +45,528 |
| % Change | 15.5 | 4.3 | 13.1 |

* August from API data

## Fig. 7—Nominal Change in Residual Stocks




### Residual Fuels Demand

Daily Average (1000 bbls.)

| | |
|---|---|
| Sept. '51 API* | 1,425 |
| Sept. '50 BM | 1,462 |
| Change | −37 |
| % Change | 2.5 |

* Through Sept. 22

Total Demand (1000 bbls.)

| | |
|---|---|
| 8 Mo. '51* | 389,196 |
| 8 Mo. '50 | 371,133 |
| Change | +18,063 |
| % Change | 4.9 |

* August from API data

**BM Forecast of Residual Fuels Demand, 1951**
(revised, June 1; 1000 b/d avg. by Quarters)
1st Q., 1,828; 2d Q., 1,523; 3d Q., 1,533; 4th Q., 1,728

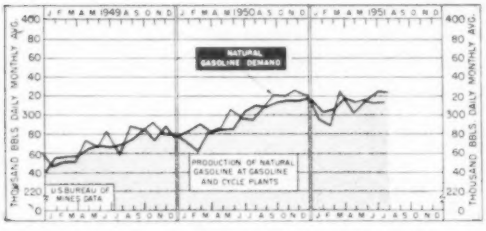
### Residual Fuel Stocks

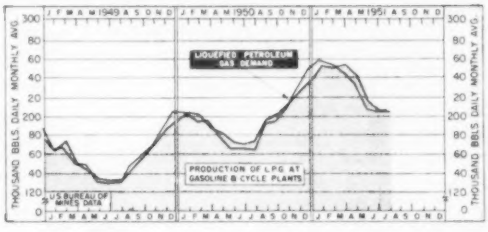
1000 bbls. end of month

| | U.S. Except California | Total U.S. |
|---|---|---|
| Sept. '51 API* | 31,870 | 47,644 |
| August '51 API | 31,815 | 47,473 |
| July '51 BM | 28,285 | 45,062 |
| Sept. '50 BM | 28,342 | 41,966 |

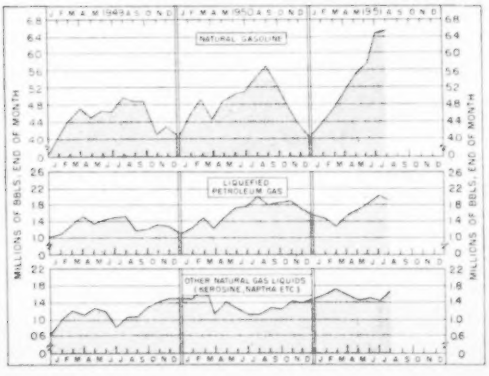
* On Sept. 22

## Fig. 8—Production and Demand of Natural Gas Liquids


NATURAL GASOLINE DEMAND
PRODUCTION OF NATURAL GASOLINE AT GASOLINE AND CYCLE PLANTS
U.S. BUREAU OF MINES DATA
THOUSAND BBLS DAILY MONTHLY AVG.


LIQUEFIED PETROLEUM GAS DEMAND
PRODUCTION OF LPG AT GASOLINE & CYCLE PLANTS
U.S. BUREAU OF MINES DATA
THOUSAND BBLS DAILY MONTHLY AVG.

## Fig. 9—Stocks of natural gas liquids




### Natural Gas Liquids Statistics

(Source: U. S. Bureau of Mines Report on Natural Gasoline and Cycle Plant Operations)

| | Production (1000 bbl./day avg.) | | | Demand* (1000 bbl./day avg.) | | |
|---|---|---|---|---|---|---|
| | Natural Gasoline | LPG** | TOTAL | Natural Gasoline | LPG | TOTAL |
| July '51 | 322 | 206 | 528 | 313 | 207 | 520 |
| July '50 | 310 | 174 | 484 | 297 | 165 | 462 |
| Change | +12 | +32 | +44 | +16 | +42 | +58 |
| % Change | 3.9 | 18.5 | 9.3 | 5.4 | 25.4 | 12.6 |

| | Total Production (1000 bbl.) | | | Total Demand (1000 bbl.) | | |
|---|---|---|---|---|---|---|
| 7 Mo. '51 | 66,941 | 49,379 | 116,320 | 65,264 | 48,715 | 113,979 |
| 7 Mo. '50 | 61,558 | 39,143 | 100,701 | 60,616 | 38,275 | 98,891 |
| Change | +5,383 | +10,236 | +15,619 | +4,648 | +10,440 | +15,088 |
| % Change | 8.7 | 26.1 | 15.5 | 7.7 | 27.3 | 16.3 |

Stocks, End of Month (1000 bbl.)

| | By Type of Product | | | By Location | | |
|---|---|---|---|---|---|---|
| | Natural Gasoline | LPG | Other Products† | Refineries | Gasoline Plants | TOTAL |
| July '51 | 6,573 | 1,919 | 1,708 | 3,840 | 6,360 | 10,200 |
| June '51 | 6,568 | 2,044 | 1,431 | 3,739 | 6,304 | 10,043 |
| July '50 | 5,445 | 2,041 | 1,254 | 2,860 | 5,870 | 8,730 |

* Demand, including exports but not transfers, is supplied from receipts from outside sources, as well as current production and stock changes at gasoline plants. Outside receipts in July totaled 62,000 bbls.

** Does not include LPG produced at refineries which in July totaled 2,463,000 bbls.

† Includes naphtha, kerosine, specialty and other products.

# ADVERTISERS' INDEX

**FOR INFORMATION ON ANY PRODUCT OR SERVICE ADVERTISED IN THIS ISSUE SEE INSTRUCTIONS BELOW**

**Each advertiser listed in this index has been assigned a code letter for use by the reader in securing additional information about advertised products or services which interest him. This code letter appears in parentheses to the left of the advertiser's name.**

**Circle the code letter on the "Advertised Product Inquiry" card (on the page opposite) which corresponds to that assigned the advertiser about whose product you want further information.**

**Fill in your name, title, company and mailing address and mail the card. . .no postage is required.**

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(I3) ALLIED CHEMICAL & DYE CORP., SOLVAY SALES DIV. .. 1068
(A2) ALUMINUM CO. OF AMERICA . 1053
(A3) ALUMINUM CO. OF AMERICA . 1093
(A4) ALUMINUM CO. OF AMERICA . 1177
(A5) AMERICAN DISTRICT STEAM CO. ..... 1170
(A6) ATTAPULGUS CLAY CO., THE . 1077
(A7) BADGER MFG. CO. ..... 1155
(A8) BETHLEHEM STEEL CO. ..... 1061
(A9) W. H. & L. D. BETZ ..... 1145
(B1) BLACK, SIVALLS & BRYSON, INC. ..... 1063
(B2) BONNEY FORGE & TOOL WORKS 1065
(B3) BOWSER, INC. ..... 1059
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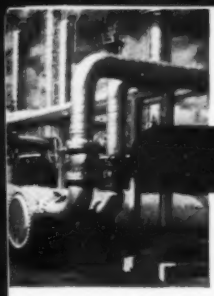
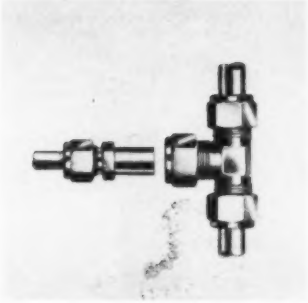


# WHAT'S NEW!

**Equipment**
**Materials**
**Processes**
**Literature**

*Reviewed by WILLIAM C. UHL, Equipment Editor*



## Reducer Fitting Designed for Joining Different Sizes of Tubing

The new Swagelok reducer fitting permits different sizes of instrument and process tubing to be joined in an assembly. It consists of a body, two ferrules and a nut. No preparatory steps on the tubing are required. The two ferrules, plus the threaded chuck inside the nut, clinch tight around the tubing wall and provide a leak-proof seal. Illustration shows a $\frac{3}{8}$-in. Swagelok reducer and a $\frac{1}{2}$-in. Swagelok all tube tee. In use, the tubing is inserted into the reducer, and the reducer nut tightened one and a quarter turns; the reducer is then inserted into the fitting, and the fitting nut tightened one and a quarter turns—which completes the assembly. Will hold heavy or thin wall tubing, and is available in brass, aluminum, steel, stainless steel and Monel in sizes ranging from $\frac{1}{8}$-in. to $\frac{7}{8}$-in. O.D. Crawford Fitting Co., 884 East 140th St., Cleveland 10, Ohio.

*Circle No.* **1** *on Reply Card*

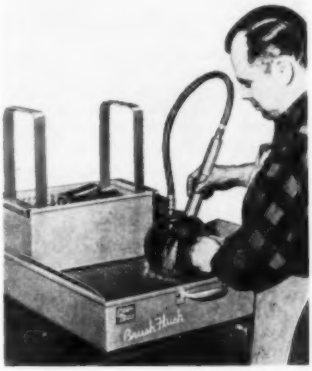
### For More Information

Use one of the attached reply cards to request additional details or literature on any items reviewed in "What's New!" Just circle the numbers corresponding to the numbers at the end of each item in which you are interested. Then fill in the rest of the card and drop it in the mail. No postage required.

## Leaks in Storage Tanks, Pipe Lines Repaired with Rubber Patch

A new method of repairing leaks in storage tanks and pipe lines employs a rubber patch vulcanized in place. The leak is sealed with a synthetic rubber plug, and then coated with a transparent cement. On top of the plug and cement are spread one coat each of three different types of adhesive. This is followed by a patch of high-carbon content uncured rubber about $\frac{3}{8}$-in. thick and finished off with a 20-gage steel backup plate. This composite patch is then subjected to heat in a specially developed heater, which cures it to within about 1/16 in. of the tank wall—the uncured portion allowing for expansion and contraction. A sample patch submitted for laboratory testing withstood a pressure of 2,120 psi. before failing. Finished patch is said to hold up well on exposure to elements, and to be durable enough to outlast the tank itself. Vulcan Patch Co., 217 West Lincoln, Montebello, Calif.

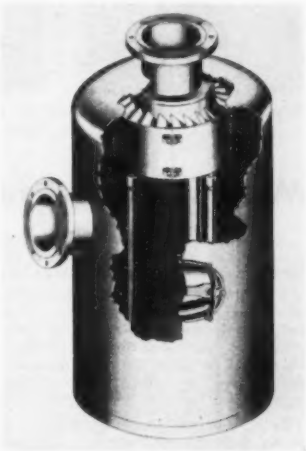
*Circle No.* **2** *on Reply Card*



## Mechanics' Bench-Type Parts Cleaner Features Hollow-Handle Brush

Maintenance and repair departments will find uses for a new bench-type parts cleaner, the Brush-Flush. It features a hollow handle brush attached by means of a tube to a pump, which produces a steady flow of clear solvent at the end of the nylon bristles. Parts are cleaned on a large screen platform, which captures dirt flushed off. Small particles of grit, chips, etc., passing through the platform screen are retained by a second filter screen at the pump intake. Includes a 2½-gal. soak tank with dip basket. Plugs into any 115-volt outlet. Priced at $49.50 FOB factory. Graymills Corp., Evanston, Ill.

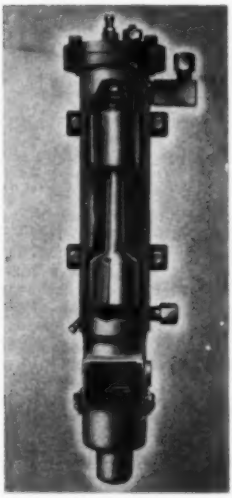
*Circle No.* **3** *on Reply Card*



## Removes Destructive Entrainment From Steam, Air Lines

A new Receiver-Type Purifier removes destructive entrainment from vapor lines. Suggested applications are (1) to protect turbines, steam engines by removing damaging slugs of entrainment, (2) in exhaust steam installations where it is necessary to remove oil and other undesirable entrainment and (3) to remove condensate from compressed air systems. In steam installations, the unit is guaranteed to deliver 99.9% quality steam, i.e., to purify boiler steam having a concentration of 1000 PPM solids to less than 0.5 PPM solids. In exhaust steam, the unit is guaranteed to remove 99% of the oil, or to deliver exhaust steam containing less than 2.5 PPM oil. Various nozzle arrangements available to meet all piping layouts. Made in nominal size from 4-in. to 16-in. V. D. Anderson Co., 1935 West 96th St., Cleveland 2, Ohio.

*Circle No.* **4** *on Reply Card*



**New evenly-graduated flow meter:** left, characterized bell; right interior of recorder housing

# Meters Flow on Evenly-Graduated Scale

Heart of a new evenly graduated flow meter recently developed by Minneapolis-Honeywell Regulator Co. is a characterized bell, shown in the left hand photograph above. This bell senses the differential pressure created by a fluid flowing through an orifice or other primary element, and moves in proportion to the square root of this differential.

When this movement is transmitted to an indicator or recorder, the result is an even pen movement for a given flow change on any part of the chart. Such an evenly-graduated flow meter is particularly suitable for integrating operations and is equally readable on all parts of the scale, thus permitting full use of the available meter range. The interior of the new meter, with chart plate removed, is shown at the right.

The bell which makes possible this even pen movement is a hollow float the inside surface of which is shaped to give a square-root response to differential pressure changes. It is housed in the meter body, with the open end sealed by a pool of mercury at the bottom of the meter body. The mercury also serves to support the weight of the bell and attached parts.

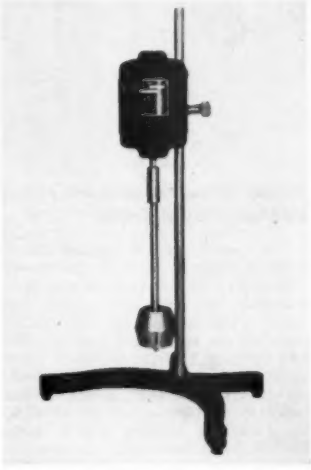
The high pressure line from the orifice goes directly into the meter body and applies pressure against the outside of the bell. The low-pressure line enters the meter body through the low-pressure tube which, in turn, passes through the mercury pool and on up inside the bell. Thus, the bell floats in mercury with high pressure on the outside and low pressure on the inside, with the mercury pool providing a seal between the two.

As flow starts through the primary element, the differential pressure created causes the mercury to assume a new level. The inner level becomes higher than the outer in proportion to the amount of differential pressure. Simultaneously, the bell moves downward in the meter body by an amount proportional to the square-root of the differential.

This bell motion is transmitted to the attached mechanical instrument through a pressure-tight bearing and a sytem of levers. In the electrical flow meter, the bell transmits motion to an armature inside the core tube of the inductance bridge transmitter by means of a shaft which extends through the low-pressure tube. This tube also provides a means of guiding the bell in its vertical movement. The bell contacts the tube at two points, one at either end of the shaped tube. Three round-nosed screws are provided at the lower end of the bell for making the necessary contact. Upward motion of the bell is limited by an externally adjustable positive zero stop.

All parts of the bell are made of corrosion-resistant metrials. The metal shell is made of pure nickel, and the attached fittings are stainless steel. The remaining parts (displacer and buoyancy ring) are molded from phenol-formaldehyde resin. This construction produces a lightweight bell, which contributes to measuring accuracy and fast response. The pressure chamber is made entirely of wrought steel, and a protective coating is applied to inhibit corrosion. The cover flange is secured by high-tensile, recessed-head cap screws, and the flange gasket is a reusable, spiral-wound type made of stainless steel and asbestos. Minneapolis-Honeywell Regulator Co., Industrial Div., Station 40, Philadelphia 44, Pa.

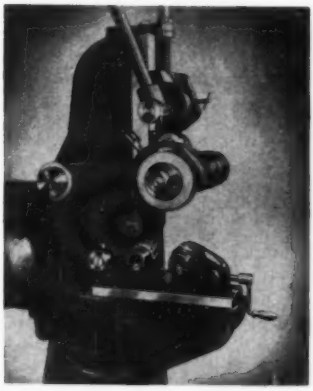
*Circle No. 5 on Reply Card*



## Two-Way Opposed Flow in Mixer Achieves Maximum Turbulence

The Duplex Dispersator can be used to mix or blend two liquids of different specific gravity. It can also be used to draw heavy solids and liquids from the bottom or light materials from the surface of a liquid to insure thorough wetting and dispersion. The device is a cylinder shaped like a double cone which revolves at high speed. The centrifugal force thus achieved forces the products under considerable pressure outward through narrow slots in the lower cone. The cylinder is open at both top and bottom, thus obtaining a two-way opposed flow, which insures intense mixing and thorough wetting action in the lower cone before products escape and are sheared through the slots. Manufacturer claims that this mixer achieves maximum turbulence and obtains intimate contact liquid/liquid, liquid/solid and liquid/gas in a fraction of the time required by propeller type mixers. Premier Mill Corp., 218 Genesee St., Geneva, N. Y.

*Circle No. 6 on Reply Card*



### De-Scaler and Cleaning Attachment Reclaims Used Pipe and Tubing

A new pipe and tube de-scaling and cleaning attachment has been announced by the maker of the Steen Cut-Off Machine. It cleans off rust, scale, paint and other deposits, and is especially adapted for reclaiming used pipes and tubes. It feeds up to 20 ft. of pipe per minute, and will handle sizes up to 12 in. in diameter. Continental Machine Co., 1952 N. Maud Ave., Chicago 14, Ill.

*Circle No.* **7** *on Reply Card*

### Faster Spraying Speeds Possible With New Metallizing Guns

Two new metallizing guns have been developed which are said to develop the highest spraying speeds yet available in guns designed for hand-held operation. Metco Type 4E is designed to spray all wires from 20 B&S gage to ⅛-in. in any metal—carbon steels, stainless, Monels, bronze—at speeds up to 40% faster than previous models. Type 5E is the first gun specifically designed for high speed spraying of the softer metals, such as zinc and aluminum, for protection of equipment and structures against corrosion. The 5E gun sprays 3/16-in. wire and will deposit as much as 55 lbs./hr. of zinc, 15 lbs./hr. of aluminum. Both guns incorporate a jet siphon principle in the gas head which automatically compensates for variations in gas pressure as high as 10 lbs., providing a steady, unvarying flame which produces uniform coatings. Metallizing Engineering Co., 38-14 30th St., Long Island City 1, N. Y.

*Circle No.* **8** *on Reply Card*

### Direct-Writing Inkless Recorder Is Developed for "SR-4" Strain Gages

The new Baldwin-Sanborn recording SR-4 strain amplifier reproduces both static and rapidly changing SR-4 strain gage measurements of strains, forces, fluid pressures, displacements, vibrations, acceleration, etc., on an inkless, strip chart with rectangular coordirates. It is a direct-writing, vacuum-tube voltmeter consisting of (1) an AC-powered strain gage amplifier of the conventional modulated carrier type in which the bridge is excited at 2500 cycles/sec. by a built-in oscillator, (2) a d'Arsonval moving coil recording galvanometer in which a current of 10 milliamps, produces a writing arm torque of 200,000 dyne-cms., and 1 cm. deflection, and (3) a paper drive mechanism. The writing arm has a heated stylus which wipes across heat-sensitive record paper, producing a black line on a white background. Standard paper speed is 25 mm./sec., but two-speed adaptors and slow speed motors are available for various combinations of speeds up to 25 mm./sec. The instrument is available in a mahogany case 17 x 11-23/32 x 9-7/16 in. overall, weighing 32½ lb., or may be obtained without the case in two sections for panel mounting. Baldwin Locomotive Works, Philadelphia 42, Penna.

*Circle No.* **9** *on Reply Card*

## DID YOU MISS THESE?

**The following items, reviewed originally in the August "What's New!" have aroused considerable interest among readers. They are repeated here briefly as a service to those who might have missed them. For details or copies of literature, use the regular reply card in this issue.**

### Air-Driven "Cono Rotomotor" Operates Catalyst Slide Valves

The "Cono Rotomotor" has been designed in a new model for the operation of catalyst slide valves on throttling control services. It is a pneumatic gear driven device, operating entirely from plant air supply and providing accurate, sensitive, and positive positioning. A continuously connected handwheel and declutching lever provide for manual operation if desired. Repositioning is accomplished by means of a tape type positioning device which permits long travels with accuracies of valve stem positioning to within 1/500th part of the total valve stroke. The device is available in a number of speeds, travels, stem diameters and thrust loads. Conoflow Corp., 2100 Arch St., Philadelphia 3, Pa.

*Circle No.* **10** *on Reply Card*

### New Field Manometer of Flexible Plastic Can be Rolled to Fit Pocket

Made of a flexible vinyl plastic material, a new field manometer can be rolled, twisted or bent into any shape, and still return to a full length, easily read and accurate U-tube instrument. In rolled-up form, it will fit into the pocket. The plastic scale is held firmly between the tubes and can be adjusted. F. W. Dwyer Mfg. Co., 317 S. Western Ave., Chicago 12, Ill.

*Circle No.* **11** *on Reply Card*

### Corrosion Notebook

*Notebook on Corrosion Resistance;* 16 pages of data on the corrosion resistance of various types of stainless tubing and pipe, by type of corrodent at various concentrations; and including descriptions of general types of corrosion. Carpenter Steel Co., Alloy Tube Div., Union, N. J.

*Circle No.* **12** *on Reply Card*

### Heat Exchange Equipment

*National Condensing and Cooling Sections,* Catalog HT-20; 16-page booklet covering design features and physical characteristics of heat transfer equipment; with design and engineering data, charts and dimensional drawings. National Radiator Co., Heat Transfer Div., 60 E. 42nd St., New York 17, N. Y.

*Circle No.* **13** *on Reply Card*

# Now

## A faster and more economical way to install U-Tubes

*Here's how the finished package comes to you. Simply remove the protective covering and the tubes are ready for installation. Either Wolverine Trufin® or plain tubes can be shipped to you on this kind of pallet.*

*At the right is shown one of the shipping pallets fully loaded. It shows the tubes bent to the correct radii, packed for immediate pallet-to-condenser installation.*

## Look at all these Advantages:

1 Tubes are fed directly, from shipping pallet into heat exchanger or condenser as they are needed! They are all bent to the correct radii and packed in the right sequence—in line or staggered—according to your prints. Removal can be made from the end or top of pallet.

2 All tubes for one condenser are shipped on one pallet.

3 Instant inspection—eliminates sorting, counting, and handling.

4 Pallet can be handled with existing equipment. Present handling equipment is needed only once to bring pallet to the job.

5 Hairpin-bend tubes eliminate one tube sheet or header.

6 Pallet saves time, crane movements, storage and working space.

7 Pallet is easily knocked down and returned. Supporting straps are cushioned with rubbery compound to protect tubes.

8 Pallet eliminates the time and expense of removing and destroying crating resulting from antique packing methods.

## Specify Wolverine Condenser Tubes—Palletized!

WOLVERINE TRUFIN AND THE WOLVERINE SPUN END PROCESS AVAILABLE IN CANADA THROUGH THE UNIFIN CO., LONDON, ONT.

**WOLVERINE TUBE DIVISION**

Calumet & Hecla Consolidated Copper Company

INCORPORATED

*Manufacturers of seamless, non-ferrous tubing*

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*Wolverine Condenser Tubes stocked by Butler Industries, Inc., 355 South Fourth Street, Beaumont, Texas • Tel.: Beaumont 5-2351*

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PLANTS IN DETROIT, MICHIGAN AND DECATUR, ALABAMA

Sales Offices in Principal Cities

Export Department, 13 E. 40th St., New York 16, N. Y.

### Special Hinged Latch on Steel Clamp Speeds up Assembly, Removal

A new stainless steel clamp, the Series 21 Quick Coupling Clamp, features a special hinged latch for quick assembly or removal. The clamp is especially designed for convenience in handling removable equipment, and provides an efficient seal for all types of hose and duct connection. Stainless steel construction makes it suitable for high temperature, pressure and corrosion resistance. Present plans are to make the clamp to customer specifications, or to engineer it to specific requirements. Specialty Products Co., 1965 East 66th St., Cleveland 3, Ohio.

*Circle No.* **14** *on Reply Card*

### Shell Chemical Is Marketing New Fuel Oil Additive

A new fuel oil additive aimed at eliminating filter screen clogging in domestic fuel oil burners is now being marketed by Shell Chemical Corp. The product, Ionad 17, can also be used in Diesel fuels to reduce clogged screens and fouled fuel-injector parts. Shell Chemical claims it reduces the severity of treatment usually required by the refiner, and that exhaustive field tests have proved it to be stable and non-corrosive. Shell Chemical Corp., 50 West 50th St., New York 20, N. Y.

*Circle No.* **15** *on Reply Card*

## Trade Literature

### What's a Servo Mechanism?

*Servomechanism Techniques in Modern System Engineering;* a 24-page, pocket-size booklet explaining in simplified terms and diagrams, just what the theory of servomechanisms is and how it is being and can be used in solving process control problems. Minneapolis-Honeywell Regulator Co., Industrial Div., Philadelphia 44, Penna.

*Circle No.* **16** *on Reply Card*

### Cut Materials Handling Costs

*The How Book of Cost-Cutting Materials Handling;* a 24-page booklet covering basic background material on types of skids, pallets and other industrial handling tools; discusses methods for evaluating present handling methods, and includes several charts and summary sheets for making a materials handling analysis. Yale & Towne Manufacturing Co., 11,000 Roosevelt Blvd., Philadelphia 15, Pa.

*Circle No.* **17** *on Reply Card*

### All-Electronic Process Control

*Swartwout "Autronic" Control System.* Bulletin A-701; four pages explaining a new, completely electrical and electronic process control system, using low voltage electrical signal transmission, to eliminate time lag over long distances; and including a new miniature-size recorder. The Swartwout Co., 18511 Euclid Ave., Cleveland 12, Ohio.

*Circle No.* **18** *on Reply Card*

### For Efficient Storage of Liquids

*Hammond Diaflote Tanks,* bulletin 51-DF; describes a new development in liquid storage tanks—the Diaflote, a flexible membrane attached to the inside periphery of the tank, which rests on the surface of the stored

YOU GET
Increased Throughput
from
Existing Equipment
WITH
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ELIMINATORS
Many refiners have found by experience that Metex Mist Eliminators, installed in stills, towers, drums, evaporators and similar equipment, have increased throughput of on-grade production and reduced operating costs by *removing 95% plus of liquid entrainment.* These knitted wire units literally "wipe out" the liquid droplets entrained in gases. Gases pass through and on . . . freed of entrainment. Liquids fall back against the rising flow.
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Full details on these entrainment separators — sizes, shapes, construction and engineering data — are found in our new 8-page bulletin. Write for your copy today. Just ask for "Metex Mist Eliminators."
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*(To obtain more data on advertised products see page* 1164)

Corruflex

**PACKLESS expansion joints**

No packing...no lubrication...no adjustment in service...no upkeep costs. You eliminate maintenance when you install *Corruflex* joints in your pipe lines. And, they're on the job all the time...absorbing expansion and contraction... protecting lines and equipment from strain. Full-time service without servicing!

*Corruflex* joints are more dependable, more efficient, longer lasting because they are made by the pioneers of the expansion joint industry. They are available in sizes from 3" to 24", single or double units, single or multiple corrugations, with or without self-equalizing rings, and with flanged or welding ends. Supplied in copper, stainless steel or other alloys and with internal sleeves if required.

*Corruflex* joints have traverses ranging from fractions of an inch to 15" and operate under pressures from vacuum to 300 psi and temperatures from sub-zero to 1600 F.

**Send for 16-page Bulletin.** Complete data on all *Corruflex* joints... simplified selection charts... summary of installation practice... *Bulletin No. P-35-51.*

**AMERICAN DISTRICT STEAM COMPANY, INC.** ★ North Tonawanda, N. Y.


## What's New!

liquid and acts as a barrier between the liquid and the air in the tank and prevents the formation of vapors; eliminates breathing and filling losses, prevents contamination of high-purity products, decreases corrosion inside tank shell, reduces fire hazards. Hammond Iron Works, 630 Fifth Ave., New York 20, N. Y.

*Circle No.* **19** *on Reply Card*

### High Speed Multiple Indicator

*Panascan—for Safety!* a four-page folder describing briefly and illustrating a new electrical system for automatic scanning, in sequence, of all process variables measurable by electricity such as temperature, pressure, flow, level, etc.; at high rates of indication—up to 90 points per minute in an actual case on temperature. Panascan, Inc., 6312 No. Broadway, Chicago 40, Ill.

*Circle No.* **20** *on Reply Card*

### New Line of Swing Joints

*Announcing Barco Swing Joints;* 4-page folder giving details on a new line of swing joints for gasoline and oil loading and unloading lines; provide 360° rotation around axis of joint, with long bearing surface to support weight of normal piping; available in sizes from ⅜ to 3 in. for threaded connections, from 4 to 12 in. for flanged connections; suitable for temperatures from −40° to 225° F., and for pressures up to 100 psi. in larger sizes and 500 psi. in smaller sizes. Barco Manufacturing Co., Dept. J-25, 1801 Winnemac Ave., Chicago 40, Ill.

*Circle No.* **21** *on Reply Card*

### Special Fabrication Services

*BS&B in the Process Industries;* 20-page catalog describing the firm's fabricated plate services, heat transfer equipment, steel and wood tanks, automatic control equipment, vent valve-flame arrestors, safety heads, walkways and stairways. Black, Sivalls & Bryson, 7500 East 12th St., Kansas City 3, Mo.

*Circle No.* **22** *on Reply Card*

### Pocket-Size Tool Catalog

*Tools of Progress,* catalog 35M; 80-page, pocket size listing of Duro-Chrome hand tools for mechanics; of particular interest to those in automotive laboratories. Duro Metal Products Co., 2649 No. Kildare Ave., Chicago 39, Ill.

*Circle No.* **23** *on Reply Card*

### Large Vertical Induction Motors

*Large Vertical Induction Motors,* bulletin 05B7629; 4-page folder giving data on ratings, construction and types of large Allis-Chalmers vertical induction motors, available in ratings upwards from 60 HP at 200 rpm. Allis-Chalmers Manufacturing Co., 1070 S. 70th St., Milwaukee 1, Wisc.

*Circle No.* **24** *on Reply Card*

### Process Variable Teletypewriter

*Metrotype Systems;* a four-page folder describing an automatic data recorder system for measuring and recording process or product variables in numerical tabulated form, at any distance from the primary element, using a standard, 60 words per minute teletype machine that will print up to 20 copies if desired. Metrotype Corp., 525 West 76th St., Chicago 20, Ill.

*Circle No.* 25 *on Reply Card*

### Heat Exchanger Cleaning

*Hydro-Blast Announces a New and More Efficient Method of Cleaning Heat Exchangers;* a four-page folder describing a high pressure water and sand blasting method and equipment for cleaning heat transfer equipment and its use in an installation at the Esso Standard Oil Co. refinery at Baton Rouge. Hydro-Blast Corp., 2550 North Western Ave., Chicago 47, Ill.

*Circle No.* 26 *on Reply Card*

### Feed Pump Rate Low as 1 cc./hr.

*Micro Feeder,* File No. SM-3005-2; folder with complete data on a single stroke, positive displacement feed pump using an accurate screw-feed and a synchronous motor for uniform, pulsation-less flow at precisely controlled rates ranging down from 800 to 1 cc./hr., discharge pressures from 175 to 2000 psig. Proportioneers, Inc. P. O. Box 1442, Providence 1, R. I.

*Circle No.* 27 *on Reply Card*

### Selecting Steam Traps

*Steam Trap Selector,* bulletin T-1750; 20-page booklet listing common process and industrial equipment, and giving size of trap required for normal operating conditions; supplements catalog on Yarway Impulse Steam Traps (see What's New for August, item no. 32). Yarnall-Waring Co., Mermaid Lane, Philadelphia 18, Pa.

*Circle No.* 28 *on Reply Card*

### Wall Chart Gives Corrosion Data

*Corrosion Wall Chart;* a 12-in. by 9-in. card gives useful corrosion resistance information for several analyses of stainless steel tubing and pipe on one side; reverse side contains data on standard tubing sizes, as well as dimensions, pressures and tolerances for stainless pipe in schedules 5, 10 and 40. The Carpenter Steel Co., Alloy Tube Division, Union, N. J.

*Circle No.* 29 *on Reply Card*

### Accurate Tank Temperatures

*Weston Averaging Resistance Thermometer,* Circular T-25-B; four-page bulletin covering principles of design and operation of a temperature indicator using a multi-unit resistance bulb which obtains readings at various selected depths of liquid in a storage tank, either cone or floating roof type; said to be especially valuable in accounting procedures on product movement. Weston Electrical Instrument Corp., Newark 5, N. J.

*Circle No.* 30 *on Reply Card*

### Welding Nickel and High Nickel Alloys

*Fusion Welding of Nickel and High Nickel Alloys,* technical bulletin T-2; 44-page booklet, giving a complete technical treatise on the subject; includes detailed instructions for various forms of electric arc welding as well as gas welding; more than 30 tables; nearly 50 illustrations. Technical Service Section, The International Nickel Co., 67 Wall St., New York 5, N. Y.

*Circle No.* 31 *on Reply Card*

### Fast Electrical Transmitters

*Atcotran Engineering Data Sheets,* illustrate and describe a line of pressure measurement transmitters which use a differential transformer type transducer and are designed for use with standard recorders and indicating instrument having dead beat re-

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(*To obtain more data on advertised products see page* 1164)

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## What's New!

sponse servo receivers, with electrical transmission up to 5000 ft. Automatic Temperature Control Co., Inc., 5200 Pulaski Ave., Philadelphia 44, Penna.

*Circle No.* **32** *on Reply Card*

### Esso's New British Refinery

*Heat Engineering*, Sept., 1951, is devoted entirely to a description of the new Fawley refinery of Esso Petroleum Co.; includes general background data on design and construction. Foster Wheeler Corp., 165 Broadway, New York 6, N. Y.

*Circle No.* **33** *on Reply Card*

### Industrial Expansion Joints

*Industrial Expansion Joints and Aircraft Bellows*, Catalog 51; 40-page booklet describing line of standard and special bellows type Sola-Flex expansion joints, available in sizes from ½ in. to 72 in. pipe size and covering pressures from vacuum to 1000 psi. Solar Aircraft Co., San Diego, Calif.

*Circle No.* **34** *on Reply Card*

### Small Size Centrifugal Pumps

*Type SCC Economy Pumps*, catalog D-851; 4-page folder describing a new line of general purpose centrifugal pumps for small pump applications, available in two sizes (2 in. suction by 1¼ in. discharge, and 1½ in. suction by ¾ in. discharge) with capacities up to 100 gpm at heads to 120 ft. Economy Pumps, Inc., Hamilton, Ohio.

*Circle No.* **35** *on Reply Card*

### Protection Against Vacuum Build-Up

*Honeywell Vacuum Breakers*, specification sheet 413-1; describes an inexpensive device ($4 to $38) for protecting equipment such as tanks, reactors and other closed vessels from damaging effects of a vacuum build-up; gives data as to sizes, construction, operating pressure, relief capacity. Minneapolis-Honeywell Regulator Co., Industrial Division, Philadelphia 44, Pa.

*Circle No.* **36** *on Reply Card*

### Pneumatic Transmission

*Republic Pneumatic Transmitters*, Form 51-9; four pages describing a pneumatic differential pressure transmitter, its operation, specifications, and technical details. Republic Flow Meters Co., 2240 Diversey Parkway, Chicago 47, Ill.

*Circle No.* **37** *on Reply Card*

### Ways to Use Steel Grating

*Versatile—Open Steel Flooring;* 16-page booklet describing types and features of steel grating, specifications, table of safe loads; photographs illustrate typical applications, including a number around refineries. Open Steel Flooring Institute, 2311 First National Bank Bldg., Pittsburgh 22, Pa.

*Circle No.* **38** *on Reply Card*

### Revised Reference on Gas Analysis

*Fisher Gas-Analysis Manual*, 4th revised edition; 60-page manual, discusses theory of gas analysis, gives details regarding procedures involved in various analyses, describes maintenance and operation of Fisher Unitized Gas Analysis Apparatus. Fisher Scientific Co., 717 Forbes St., Pittsburgh 19, Pa.

*Circle No.* **39** *on Reply Card*

### Product Control by Infrared Analysis

*Product Control by Infrared Analysis;* 8-page brochure describes specific applications of infrared analysis to product control problems and explains in simple language how infrared works. Perkin-Elmer Corp., Norwalk, Conn.

*Circle No.* **40** *on Reply Card*

### Facts About Materials Handling

*Basic Facts About Materials Handling;* 24-page pocket-size booklet discusses efficient handling and storage of materials. Clark Equipment Co., Industrial Truck Division, Battle Creek 62, Mich.

*Circle No.* **41** *on Reply Card*

### Chemistry of Nitrosyl Chloride

*Nitrosyl Chloride;* a 78-page article reviewing the preparation, properties and use of this chemical, including its reactions with various hydrocarbons; reprinted from *Chemical Reviews* for June, 1951. Solvay Process Div., Allied Chemical and Dye Corp., 40 Rector St., New York 6, N. Y.

*Circle No.* **42** *on Reply Card*

### Controller Has Single Adjustment

*Taylor "Transet Bi-Act" Controller;* four pages of technical details on the operating principles of a new force-balance control circuit with two control responses, proportional and automatic reset, adjusted by only one knob; adaptable particularly to flow applications requiring fast reset rates and broad throttling bands. Taylor Instrument Cos., Rochester, N. Y.

*Circle No.* **43** *on Reply Card*

### Retains Original Insulating Value

*Foamglas Insulation for Piping and Process Equipment;* 24-page booklet describing properties and uses of PC Foamglas—a rigid cellular glass insulating material which retains its original insulating value; gives details on application and data on available shapes and sizes. Pittsburgh Corning Corp., 307 Fourth Ave., Pittsburgh 22, Pa.

*Circle No.* **44** *on Reply Card*

### Arc Tangent Coordinate Paper

*Arktan Bulletin;* describes the new Dyleski "Arktan" arc tangent coordinate graph paper and its use for curve plotting in scientific, mathematical, engineering, and statistical analysis. Orbit Electric Co., 2710 North Menard Ave., Chicago 39, Ill.

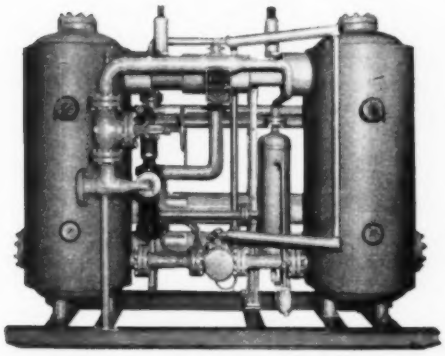
*Circle No.* **45** *on Reply Card*

### Centrifugal Blowers, Compressors

*De Laval Centrifugal Blowers & Compressors,* bulletin 0500; 52-page booklet containing data on three types

### For Your Convenience

Business reply cards are included in each issue of PETROLEUM PROCESSING to assist you in obtaining more information on any items reviewed in "What's New!" You'll find them facing the first page of this section. Just circle the numbers corresponding to the numbers at the end of each item in which you are interested. Then fill in the bottom of the card and drop it in the mail. No postage required.

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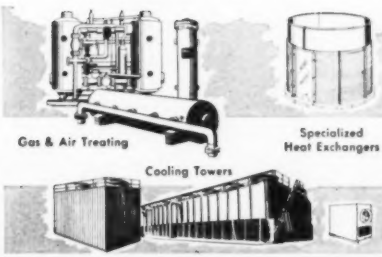


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## What's New!

of De Laval centrifugal blowers and compressors: multistage, single stage—end suction, and single stage—double suction; covers application data, design and construction, and drives; includes 14 pages of engineering data, curves, formulas and examples for computing compression of gases and pipe friction. De Laval Steam Turbine Co., Trenton 2, N. J.

*Circle No.* **46** *on Reply Card*

## Literature Offered in This Issue's Advertisements

Do you need detailed information on a specific subject? Check through this easy-to-use index of literature offered in this issue:

ADDITIVES, for lube oils: Information. See adv't. p. 1057.

ALLOYS, for high temperature service: "High Temperature Work Sheet". See adv't. p. 1094.

ALLOYS, nickel, in wrought forms: Booklet. See adv't. p. 1072.

BLENDER, automatic: Descriptive literature. See adv't. inside front cover.

BLENDER, automatic, oil: New booklet. See adv't. p. 1059.

CATALYST SUPPORTS, ceramic alumina balls: Information. See adv't. p. 1053.

CATALYST SUPPORTS, fused alumina: Bulletin No. 140. See adv't. p. 1045.

CAUSTIC SODA: Technical Data Sheet. See adv't. p. 1081.

COMPRESSORS, centrifugal: Information. See adv't. p. 1064.

COMPRESSORS, centrifugal: Bulletin. See adv't. p. 1100.

CYCLOVERSION PROCESSES: Full information. See adv't. p. 1054.

DEHYDRATION, for instrument air and other gases: Bulletin No. 16.0.080. See adv't. p. 1173.

EXPANSION JOINTS, packless: Bulletin No. P-35-51. See adv't. p. 1170.

FIRE-FIGHTING, air foam type: Reference catalog. See adv't. p. 1141.

FIRE-FIGHTING, mechanical foam, for polar solvents: Bulletin 500A. See adv't. p. 1175.

FLOATING ROOF: Bulletin on how to reduce vapor losses. See adv't. p. 1046.

FLOW CONTROL, transmitters: Bulletin 420. See adv't. p. 1146.

FLOW METERS, positive displacement type: Bulletin 40-B-14. See adv't. p. 1136.

GAS ANALYZERS, oxygen, for fuel conservation: Bulletin 50-829. See adv't. p. 1070.

GAS PROCESSING: Bulletin. See adv't. p. 1095.

HEAT EXCHANGER, air-cooled: Information. See adv't. p. 1137.

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## What's New!

HEAT EXCHANGER, air-cooled: Bulletin. See adv't. pp. 1084-1085.

HEAT EXCHANGERS, cleaning & descaling: Bulletin F7629. See advt. p. 1099.

HEAT EXCHANGERS, sectional hairpin: Bulletin No. 481. See adv't. p. 1074.

HOOVER REPORT: Booklet "Will We Be Ready?". See adv't. p. 1179.

HYDROFLUORIC ACID, aqueous and anhydrous: Technical Service Bulletin No. 30-A. See adv't. inside back cover.

KNOCK, engine: Literature on causes. See adv't. facing pp. 1100-1101.

MIST ELIMINATORS: 8-page bulletin. See adv't. p. 1169.

MIXERS, fixed mounted, top and side entering: Bulletin TD-600. See adv't. p. 1156.

PAINT, corrosion-resistant: Bulletin 720. See adv't. p. 1071.

PIPE FITTINGS, welded: Catalog. See adv't. p. 1065.

PIPE MAINTENANCE: Training handbook "Piping Pointers", also a sound film. See adv't. p. 1089.

PROCESS EQUIPMENT, all types: Descriptive literature. See adv't. p. 1074.

PUMPS, controlled volume: Bulletin No. 151. See adv't. p. 1073.

PUMPS, cycling jet: Bulletin 5030. See adv't. p. 1080.

PUMPS, ejector: Bulletin 5080. See adv't. p. 1080.

PUMPS, sump: Bulletin 4929. See adv't. p. 1080.

REFRACTORY LINING, plastic: Information. See adv't. p. 1082.

SAFETY HEADS: Detailed catalog. See adv't. p. 1063.

SEALS, mechanical: Bulletin No. DSPP. See adv't. p. 1178.

SEPARATORS, oil-water, for waste disposal: Operating data: See adv't. p. 1150.

STEAM TRAPS: Catalog 68-Q. See adv't. p. 1060.

STEAM TRAPS: Catalog 751. See adv't. p. 1148.

TANK CLEANING: 52-page booklet. Serial A-1134. See adv't. facing pp. 1100-1101.

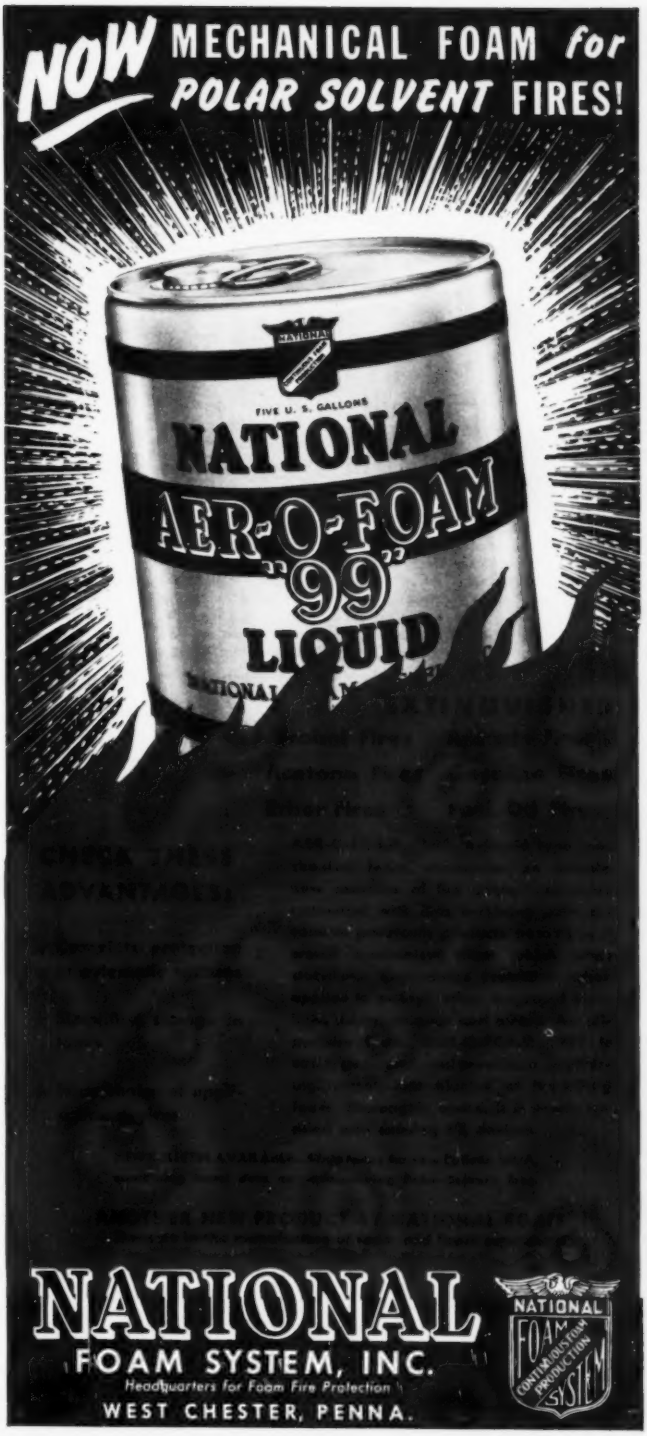
TUBE ROLLING, controlled: Booklet. See adv't. p. 1171.

TUBING, aluminum: Booklet. See adv't. p. 1177.

TUBING, aluminum, for air-cooled heat exchangers: 24-page booklet. See adv't. p. 1093.

VALVES, control: Bulletin 700-2. See adv't. p. 1138.

VALVES, for high temperature and corrosive service: Information. See adv't. p. 1135.

# New ISA Officers Elected at Houston

A. O. Beckman—pres.

D. M. Boyd, Jr.—v-pres.

Robt. T. Sheen—v-pres.

New officers of the Instrument Society of America for 1951-52 were elected during the Houston meeting, as follows: **A. O. Beckman** (Beckman Instruments, Inc.), president; **David M. Boyd, Jr.** (Universal Oil Products Co.), vice president; and **Robt. T. Sheen** (Milton Roy Co.), vice president. In addition, **W. A. Wildhack** (Bureau of Standards) moves up from vice president to first vice president; and **N. L. Isenhour** (Carbide & Carbon Chemicals Co.) continues as vice president, and **G. R. Feeley** (Trinity Equipment Co.) as treasurer. **Dick Rimbach** was re-elected secretary, and **Percy Jones** was appointed business manager. Retiring officers include **J. B. McMahon** (Republic Flow Meters Co.), president; **Porter Hart** (Dow Chemical Co.), first vice president; and **Nelson Gildersleeve** (General Electric Co.), vice president.

---

**Dr. Arman E. Becker,** consulting engineer and physicist of the Research Division of Standard Oil Development Co., retired Sept. 1 after more than 31 years service with the Jersey Standard interests. A native of Ohio, he attended Marietta College and received his masters degree and doctorate in physics from Harvard, the latter in 1917.

Dr. Becker

He joined the National Advisory Committee for Aeronautics and was placed in charge of the testing and performance of fuels and lubricants in aviation engines in the first altitude chamber ever constructed. In the first World War he was with the Signal Corps in its Aviation Branch. After the war he conducted research on bearings for the Aluminum Casting Co., Cleveland.

In 1920 Dr. Becker joined the Standard Oil Co. (New Jersey) as head of lubrication research in the research laboratory. He was placed in charge of the engine laboratory in 1929, became assistant to the director of standard inspection laboratories and in 1948 was made a member of the SOD research division.

Dr. Becker wrote the first engine knock testing manual for SOD, which received wide distribution throughout the petroleum industry. He is a member of various scientific societies and holds a number of patents in the field of fuels and lubricants.

* * *

**Dr. Curtis F. Gerald** has joined the engineering, research and development department of Universal Oil Products Co., Chicago.

Dr. Gerald, formerly associated with Universal Oil at its Riverside, Illinois laboratories, returns to the company after an absence of four years, during which time he served as an assistant professor of chemical engineering at the University of Washington, Seattle.

Mr. Gerald

From 1942 to 1947 he was employed as a research chemical engineer with Universal.

He is a graduate of Iowa State College and holds graduate degrees from the University of Cincinnati and Massachusetts Institute of Technology.

* * *

**Randal Maass,** assistant manager of the General Petroleum Corp.'s refinery at Torrance (Calif.), has accepted the position of assistant manager of the Standard-Vacuum Petroleum Maatschappij refinery at Palembang, Sumatra, Republic of Indonesia.

Mr. Maass, a graduate of the California Institute of Technology, joined General Petroleum in 1934 as a laboratory technician. He worked as a laboratory chemist, a gas engineer and as a refinery engineer before being named assistant manager of the Torrance refinery in 1949.

Mr. and Mrs. Maass will leave for Holland shortly to visit the SVPM office for orientation. After a month there, he will proceed to Palembang while she will return to California for a short sojourn before embarking.

* * *

**William Kaplan** has been appointed director of the automotive research laboratory of Pan American Refining Corp., in Baltimore. He graduated in chemical engineering from MIT in 1927 and in 1941 joined the research department of Pan American, his latest position being in the Texas City laboratory as section chief in charge of technical service.

* * *

**C. A. Pollard** has been named general manager of the California Standard refinery at El Segundo, Calif., succeeding **E. E. Lyder,** retiring after 26 years with the company.

Mr. Lyder

Mr. Pollard has been assistant general manager of Standard's Richmond refinery since 1949. He joined the company in 1916 as a roustabout, returned to the University of California in 1919 and received a degree in 1921, then resumed with Standard. Mr. Pollard has performed a number of assignments in the manufacturing department and spent several years at El Segundo as foreman of the low pressure distillation division.

Mr. Pollard

Mr. Lyder joined the company at Richmond as a research specialist in 1925. Before his appointment as general manager in April, 1950, he had served as superintendent of the cracking division.

**C. W. Rehfuss,** formerly manager of operations, succeeds Mr. Pollard as asst. general manager at Richmond. A chemical engineering graduate of Stanford, he has been with Standard

since 1924, at Richmond since 1940.

At El Segundo, **J. A. Hapke** was appointed manager of service divisions from superintendent of light oil division. **C. D. Lewis** was moved from assistant superintendent of package and utility division to superintendent of light oil division. **P. N. Johnson** went from superintendent of organization and cost control to assistant superintendent of package and utility division. **C. D. Barker** advanced from foreman of light oil division to superintendent of organization and cost control.

* * *

**Dr. Vladimir Haensel,** Universal Oil Products Co., has been named the 1952 recipient of the Precision Scientific Co.'s Award for achievement in petroleum chemistry. Announcement of the $1,000 citation was made at a Diamond Jubilee meeting of the American Chemical Society in New York.

**Dr. Haensel**

The Award, which is administered by the American Chemical Society, will be presented to Dr. Haensel sometime next spring.

He is now division coordinator in charge of Universal's Cracking Research at the company's Riverside, Illinois laboratories.

* * *

**M. E. Holmberg,** metallurgist, has opened consulting engineering offices in the Bermac Building, 4101 San Jacinto, Houston. For the past 15 years Holmberg has been associated with the Phillips Petroleum Co. at Bartlesville, Okla. where, for 10 years, he served as manager of Phillips test Division.

**Mr. Holmberg**

After his graduation in metallurgical engineering from Pennsylvania State College in 1931, Mr. Holmberg was employed by the Aluminum Co. of America. In 1932 he went with Black, Sivalls and Bryson Inc. as metallurgical and welding engineer. He transferred to the Phillips Petroleum Co. in 1936.

* * *

Recent changes announced at Shell Development Co. are as follows:

**Richard D. Mullineaux,** who recently received his Ph.D. in organic chemistry from the University of Wisconsin, has joined the staff.

**Ross E. Van Dyke,** formerly instructor in chemistry at Johns Hopkins University, has joined the staff and is working in the colloid chemistry field. Mr. Van Dyke, holder of a Ph.D. degree in chemistry from Brown University, received his undergraduate training at Gettysburg College and was connected with the Manhattan project during World War II.

**A. B. Bullock** of Shell Development Co., Emeryville, is at New York University where he is studying recent developments in the field of microchemical analysis. He plans to return to the laboratory early in 1952 and will be in charge of microanalytical work at Shell Development. Mr. Bullock, a graduate of the University of California in 1934, has been with Shell Development for 15 years. One of their first workers in the microchemical field, he has been active in personnel work prior to his present assignment.

**John A. Buckland** and **Howland A. Larsen** have joined the development staff. Mr. Buckland recently received his Ph.D. in chemical engineering from Pennsylvania State College, and Mr. Larsen holds a M. S.

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(To obtain more data on advertised products see page 1164)

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## Personals

in chemical engineering from the University of Illinois.

* * *

**L. C. Beard, Jr.**, asst. director of Socony-Vacuum Laboratories, and **K. G. Mackenzie**, assistant to vice president, The Texas Co., have been named to the General Committee on Arrangements for the 50th Anniversary Meeting of the American Society for Testing Materials. The meeting will be held in New York City the week of June 23, 1952.

Mr. Beard is chairman of the Non-Technical Program Committee, and Mr. Mackenzie is chairman of the Finance Committee.

* * *

**K. L. Hollister** is in charge of a new technical service field office in Detroit, opened by The Texas Co. for the purpose of maintaining a close working liaison with the automotive industry. He will cooperate with the manufacturers of passenger cars, buses, trucks and allied equipment on problems relating to fuels and lubrication. He will also aid in coordinating Texaco's research activities in this field in line with current technical problems.

Mr. Hollister

Mr. Hollister graduated from the University of Michigan a mechanical engineer in 1926 and spent the following 6 years with the Ingersoll-Rand Co., becoming technical assistant to the sales manager. In 1932 he joined The Texas Co., where he has been active in the fields of technical and manufacturers' service.

* * *

**Joe Wood**, chief chemist for Skelly Oil Co.'s research laboratory, has been appointed chairman of Natural Gasoline Assn. of America's Technical Committee. He succeeds **H. A. Montgomery**, Houston, Warren Petroleum Corp., who piloted the committee for three years. **J. L. Thompson**, Dallas, Lone Star Producing Co., is vice-chairman. Both appointments were made by NGAA president **J. F. Lynch**, Corpus Christi, La Gloria Corp.

Mr. Wood also will direct the LP-Gas subcommittee investigation of odorants as warning agents in domestic service. **Dr. E. H. Koepf**, Dallas, Atlantic Refining Co., was named chairman of the High Pressure Absorption Committee, while **A. J. Miller**, Bartlesville, Phillips Petroleum Co., will continue to direct activities of the Fractional Analysis subcommittee. The latter group is working on improvements in analytical methods to obtain more accurate results, the

studies being made by 58 oil company and commercial laboratories.

**K. C. Bottenberg,** Bartlesville, Phillips Petroleum Co., will head the Plant Control Test subcommittee.

* * *

**Dr. Donald L. Katz** has been appointed chairman of the department of chemical and metallurgical engineering, University of Michigan, to succeed **Dr. George Granger Brown,** now Dean of the College of Engineering. Dr. Katz received his Bachelor of Science degree in 1931 and his Doctorate in 1933 from the University of Michigan.

In June 1933, he was employed by the Phillips Petroleum Co., of Bartlesville, Okla., to develop a research program in the field of oil and gas production. Measurements were made of vapor-liquid equilibria at high pressure and a program of sampling high pressure oil and gas wells was initiated. A method of computing oil and gas reserves was developed and early studies in reservoir engineering were initiated. In 1936 Dr. Katz returned to the University of Michigan as assistant professor of chemical engineering. In 1942 he was made an associate professor, and in 1943, professor of chemical engineering.

* * *

**John Tench,** manager of the Shell Oil refinery at Martinez (Calif.), hosted 12 European safety experts during a recent one-day visit, part of their two-month tour of American industries under ECA-Labor Department sponsorship. Visitors studied accident prevention methods. Martinez was the only Pacific Coast refinery they visited. It has won five National Safety Council awards for "distinguished service to safety", a national record, according to Shell.

* * *

Three changes in the engineering department of Phillips Petroleum Co. **C. E. Rawlins** has been made manager of the test division, replacing **M. E. Holmberg** who resigned to join a consulting engineering firm. Mr. Rawlins has been employed by Phillips since July, 1937, and has been in the test division since 1940.

**M. A. Patrick** has been made assistant manager of the construction division and will be responsible for all field construction work of the engineering department. He has been a Phillips employe since April, 1933, and recently was transferred to Bartlesville from Borger, Texas. He formerly was assistant general construction superintendent.

**L. L. Kasparek** has been promoted from project engineer to assistant manager of the construction division, with headquarters in Bartlesville. He has been with the company since May, 1939. He will be responsible for the construction division activities of the Bartlesville office.

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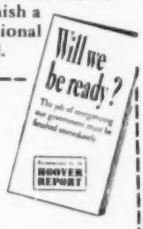


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# EDITORIAL VIEWPOINTS

Opinions and Comments on Current Topics

## PAD and Its Future Personnel

IT HAS been fortunate for the industry that the Petroleum Administration for Defense has been staffed in its early days by thoroughly competent men, many of whom served with its predecessor, the Petroleum Administration for War, and thus gained experience as liaison agents between the petroleum industry and the government. Under the rotation system in effect, the men who have replaced the original incumbents in office under Deputy Administrator Bruce Brown have also been men of high caliber.

Now that the work of organizing PAD and launching the activities of this most important agency in the nation's mobilization program is under way, it would be mistaken thinking to assume that in the future less competent men can serve adequately as directors of the various PAD Divisions or carry on its work. In some quarters, however, the impression exists that in the months to come, short of war, less able men can be granted leaves of absence from their companies to serve with PAD. The oil companies should keep in mind that the professional bureaucrats in Washington are at all times alert for a slip or mistake on the part of PAD's personnel that will furnish them with a pretext for trying to move in on the work and control of this agency. Such a move was contemplated, it will be recalled, in the proposal to the President that only the professional bureaucrats serve as chairmen of industry committees and groups in all phases of the mobilization program.

Like PAW, the Petroleum Administration for Defense is successfully demonstrating how industry men can cooperate and function with the government in an emergency, and still preserve for that industry its traditional freedom of initiative and opportunity for individual enterprise. Many in Washington would like to see it stub its toe. We may be sure that any misstep will be seized upon as showing the ineffectiveness of industry groups in general in directing their industry's participation in the mobilization effort, and proving that they should be replaced by professional government bureaus. The best way to guard against this calamity is for oil company management to continue to name only competent men to take their turn on PAD's staff.

—V.B.G.

## Union Oil Does Industry a Favor

THIS issue of PETROLEUM PROCESSING carries a rather detailed story of the $1,685,000 tank farm fire which Union Oil of California experienced at its Wilmington refinery last July. It starts on p. 1115. It tells what happened, and why, and includes some pretty valuable information for everyone concerned with plant fire protection. Some of the lessons pointed up by the fire were already pretty well known by Union Oil and the industry, some of the others may help prevent similar conflagrations in the future.

As far as we know, this is the first time a company has gone this far in revealing the data uncovered in a post mortem of such a fire. As one company officer put it to us—"I feel that we're doing the industry a service in supplying this information."

Union Oil Co. and its management are to be commended for this far sightedness. Such cooperation as this helps make the oil industry better and safer.

—W.F.B.

## Wanted—more engineering students!

PROGRAMS to help solve the problem of the increasing shortage of engineers in this country are now gaining momentum. Industry and the military alike are feeling the effects of this major problem and top level people in both groups are receiving a broadside of appeals, suggestions and plans for overall methods of easing the squeeze on technological and scientific manpower.

But there is still one important job to be done. High school and college students with the required aptitudes and skills must be urged and encouraged to enter the engineering profession, to continue their studies with that end in mind.

What can the individual—the petroleum processing engineer for example—do on this problem? Much, according to experts concerned with it. The best approach was clearly outlined by Dr. Everett S. Lee, of General Electric's research division, speaking before a meeting of the American Society of Mechanical Engineers in Houston recently:

Go to the schools in your community and explain the problem to officials, Dr. Lee suggested. Ask for a chance to talk to groups of students in assemblies and classes, or to interview individual students. Sell the profession to them and urge them not to waste their potential talents outside the field. Explain that the growth in opportunities in engineering is not based solely on the war conditions but also is firmly grounded on the natural progress in American technology and science. Sell your own enthusiasm. And sell it now.

—W.C.U.

## The Minor Pleasures of Life

A Cleveland bus driver was held up by slow traffic the other day. An impatient truck driver trailing along behind finally managed to squeeze by. He gunned his engine as he did so, cutting hard and close in front of the bus, and yelling something—unintelligible but probably unpleasant.

Just a few blocks further along the bus driver met the trucker again. The truck had hit a car along the side of the street.

This incident doesn't have a darned thing to do with processing petroleum—but how many times we've wished it would happen to us.

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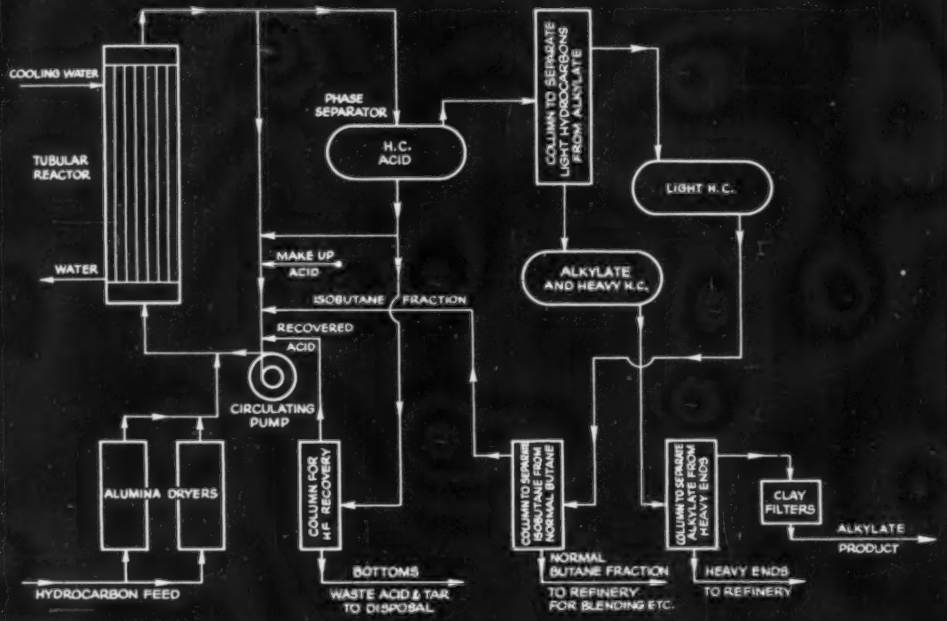


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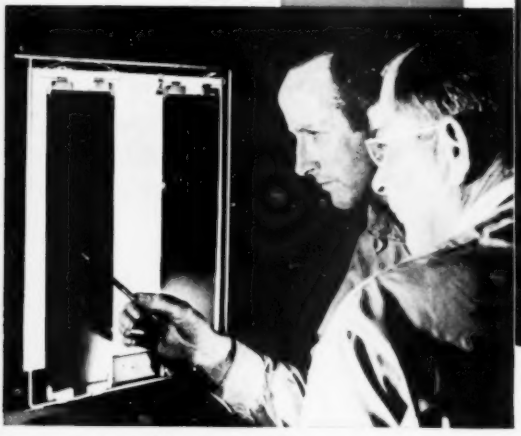

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